Vol. XXVI. Part 11.

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The Journal of the Department of Agriculture of Victoria, Australia.

Nov., 1928.

PRINCIPAL CONTENTS

Chemistry in Agriculture

Dairy Chemistry

Insect Pests Insect Friends

Foul Brood in Bees

The Poultry Industry

Wheat-growing in the Mallee

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THE JOURNAL

OF

THE DEPARTMENT OF AGRICULTURE,

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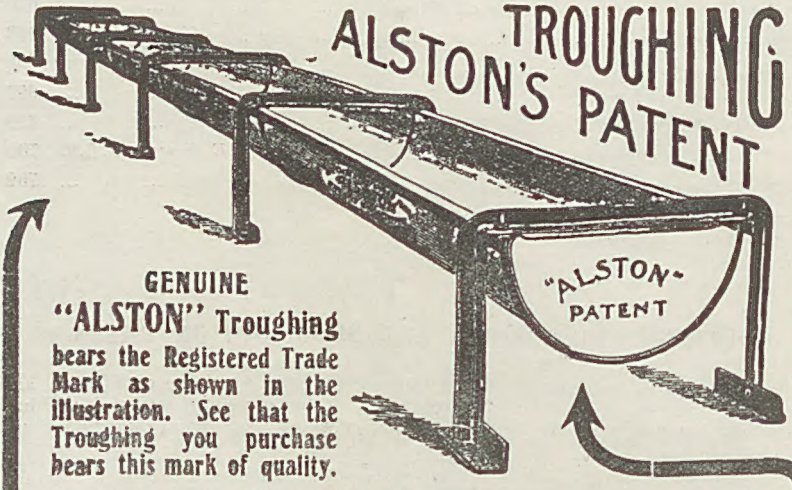

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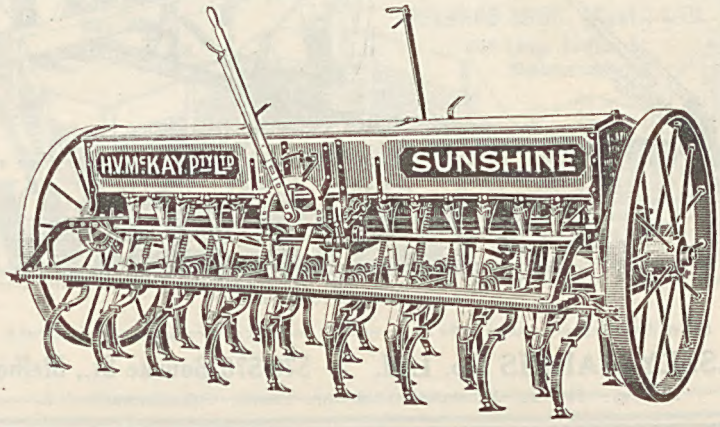

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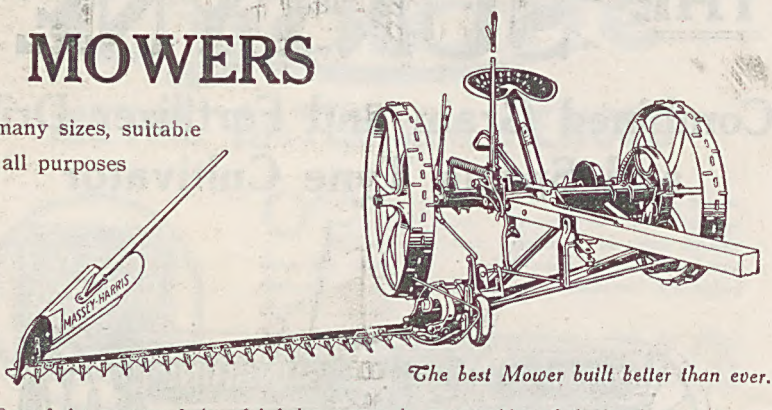

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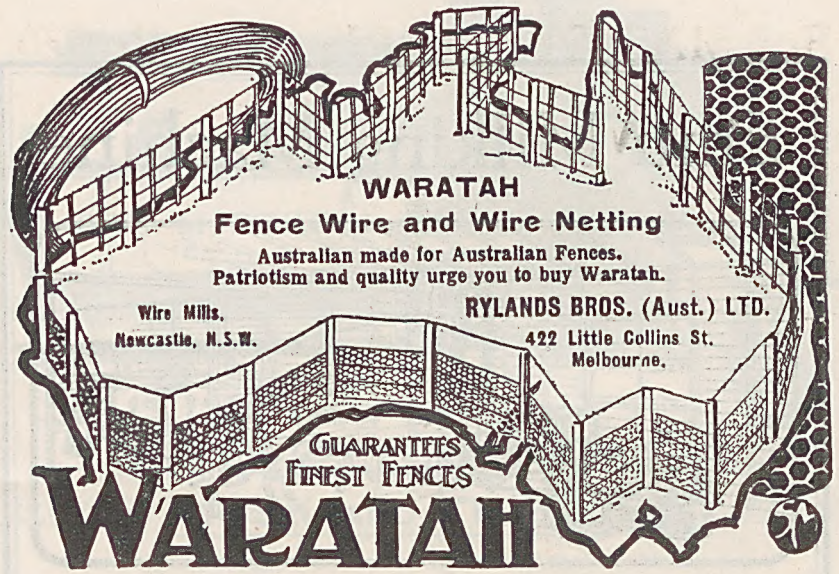

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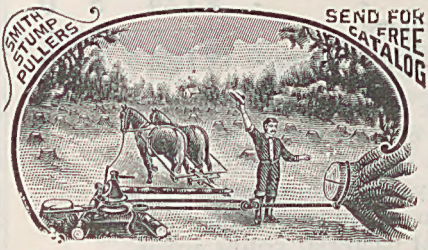

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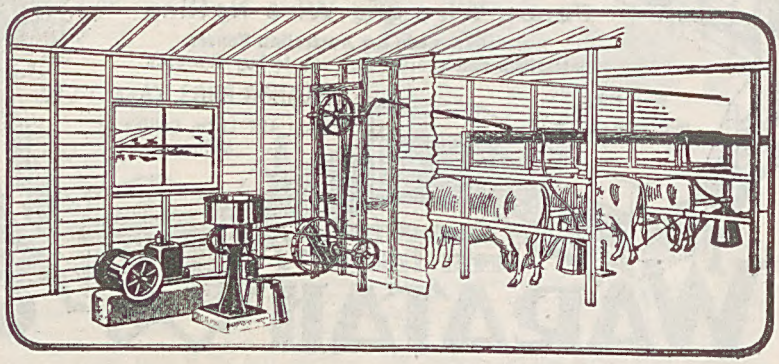

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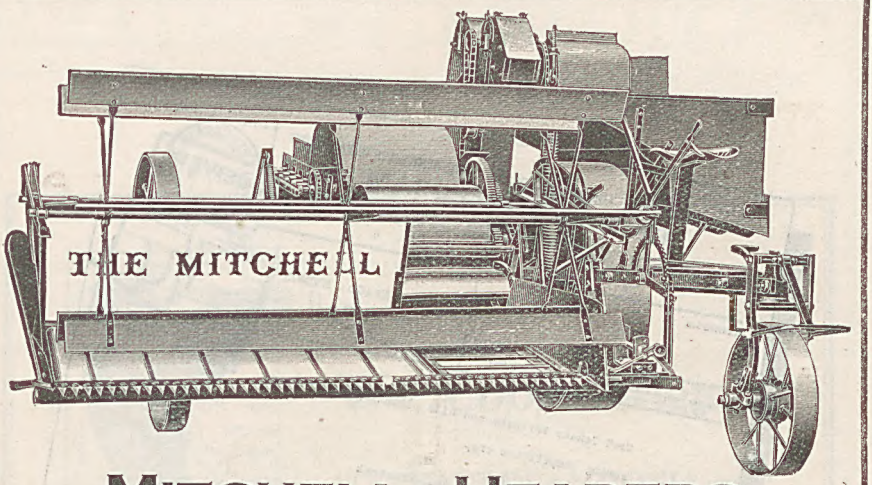

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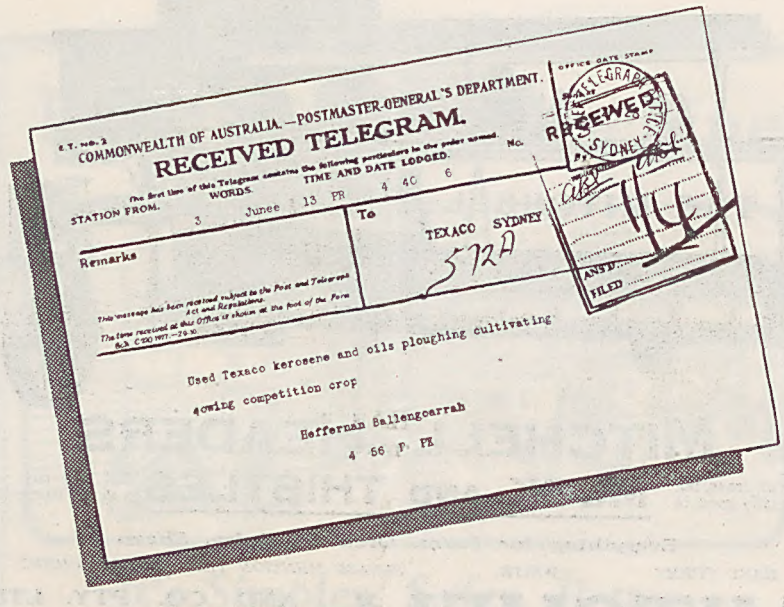

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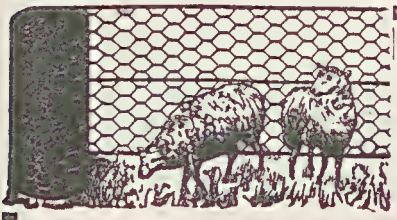

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THE JOURNAL

OF THE

Department of Agriculture

OF

VICTORIA.

Vol. XXVI. November, 1928. Part 11

CHEMISTRY IN AGRICULTURE.

The Chemist's Part in the Maintenance of Soil Fertility.

W. R. Jewell, M.Sc., F.I.C., F.A.C.I., Agricultural Research Chemist.

In continuation of the series on the influence played by Chemistry in Agriculture, this article will deal with the part played by chemists in the important problem of maintaining soil fertility.

Sir Humphrey Davy was one of the earliest workers in this field, but the first significant progress was made in 1840, when Liebig proposed his theory of soil fertility. He discarded the old theory that plants feed on the organic matter in manure and soil, and maintained that it was the mineral part of the soil alone that was necessary for plants, and that they build their organic matter from carbon-dioxide and nitrogen in the air. He proceeded to test the correctness of his theory on a particularly barren piece of land, with successful results. Liebig's theory was merely the starting point in the attempt to ascertain the fundamental principles of soil fertility. Those minerals necessary for plant life and those absent from the soil or not present in sufficient amount remained to be determined. The general principles of soil fertility have been discussed in a previous article,* and at present we are concerned with the chemical aspects of maintaining soil fertility.

Other chemists took up the work, and practical men were impressed with the possible utility of the theory. About the same time, John Lawes, later better known as Sir John Lawes, made the important discovery that bone meal treated with sulphuric acid was more effective than untreated bone meal in its effect on plant growth. It had long been known that bones were beneficial to plant life, but why they were beneficial was not known. As soon as chemists found that bones, and particularly bones treated with sulphuric acid, were beneficial on

* See this *Journal* for August, 1928.

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account of their phosphoric acid content, a search was made to discover other sources of phosphoric acid. Sir John Lawes found that mineral rock phosphates when treated with sulphuric acid similarly yielded phosphoric acid in forms available to plants. The product which he obtained and tested as a fertilizer is known as superphosphate. When one considers that in Australia alone about three-quarters of a million tons of this material are now used annually, one realizes the importance to agriculture of this chemical discovery.

Lawes patented his discovery in 1842, and his factory, the first of its kind, became the foundation of the present enormous fertilizer industry. Immense deposits of phosphate rock were discovered in various parts of the world, and, together with sulphuric acid (the manufacture of which involves another romance of chemistry), form the raw materials of the superphosphate industry. Lawes began his field experments at Rothamstead, and from this beginning there has developed the most famous experiment station in the world, so well known as to need no description here.

Liebig's theory of mineral nutrition of plants was astray in so far as it related to nitrogen; subsequent investigations have shown that ordinary crops cannot take nitrogen from the air, as he supposed. Yet clovers and other legumes were known to aid in maintaining soil fertility. This mystery was not explained until two chemists showed that legumes possessed bacteria which fixed nitrogen from the air into chemically combined nitrogen available to the plant. Further investigations revealed that nitrogen is essential to plant life, and that it is deficient in many soils. Search was made for sources of nitrogen, a description of which was given in the article on nitrogenous fertilizers (see this *Journal* for August, 1925).

Another important chemical discovery was the use of potash as a fertilizer. Common salt had been mined in Germany for some time, but other salts, originally of no value, were associated with it, and were used to fill in abandoned portions of the mine. Chemists found this waste material contained potash, and that some soils do not contain enough potash to give heavy crops. Thus these potash salts, which were waste products, have now become more valuable than the common salt, for which the mines were originally designed.

These discoveries relating to phosphoric acid, nitrogen, and potash are outstanding ones concerning soil fertility, but, great as they are, they represent only a small part of what chemists have done to aid in the maintenance and increase of soil fertility. Many chemists in various parts of the world have made numerous discoveries and collected a great mass of detailed information, and the work still goes on. Recent discoveries of the importance of very small amounts of certain minerals have been discussed earlier.

The maintenance of soil fertility is largely dependent upon restoring the necessary elements removed by crops, and, conversely, soil naturally poor can be increased in fertility, a process which can be seen in almost any locality.

Farmyard manure has for ages been esteemed for its favorable action on the soil. The agricultural chemist has estimated its phosphoric acid, nitrogen, and potash contents, and has studied the best

methods of saving and applying it. He has found that manure must be kept moist to reduce losses by fermentation, and protected from leaching by rain, so that plant food may not be washed out. Manure contains a relatively small proportion of plant-food constituents, but it is of importance, because of the organic matter it contains, which builds up humus in the soil. Plants, like animals, need not only food, but a suitable amount of water and a favorable place in which to live and develop. Favorable soil conditions are equally as important as plant food. Manure and green crops turned under help to maintain favorable soil conditions.

As farmyard manure becomes more and more difficult to obtain in adequate quantities, and as it is so beneficial under certain climatic conditions, investigations were carried out at Rothamstead to develop a process of making synthetic farmyard manure. This process was the outcome of a purely scientific study of certain cellulose-decomposing bacteria, and the practical application has been that farmyard manure can be made from straw, leaves, and many other waste vegetable substances.

Similarly, the soil condition as regards acidity or alkalinity is of great importance. Soil acidity has received, and still receives, considerable attention from agricultural chemists. There are great variations in the behaviour of crops to acid soils. Some few crops do best on acid soils, and are injured by applications of lime to correct acidity, while others are definitely injured by acid conditions. There are various degrees of acidity, and plants vary in their tolerance to acidity. The whole question of soil acidity is a perplexing one, and, while a considerable amount of work has been done, the problem is not yet solved, and is more complex than first appeared. Acidity may be caused by several factors, and the behaviour of crops depends on the cause of the acidity as well as on the degree. Many acid soils must be corrected by lime before most crops will grow, while, on the other hand, overliming may cause bad results, so that the question of liming must be considered from the narrow aspect of the locality in which liming is proposed. The physical condition of the soil is also of importance in considering the maintenance of soil fertility, and the alteration of texture by the application of soil amendments, such as gypsum and lime, has received considerable attention.

The development of commercial fertilizers brought many problems to the agricultural chemist. A most important one is that of the relative availability of the same plant food in different forms. Phosphoric acid, nitrogen, and potash occur in different forms of combination. Some of these act quickly and are of high value; some are of no practical value, and others are intermediate in value. Potash in soluble salts has a high value, but potash also occurs in silicates, from which the potash can be extracted only by intense chemical treatment, and only very slightly by plants. Nitrogen in nitrate or sulphate has a high value, while in peat or untreated leather it has a very low value. Phosphoric acid may be applied as bone, superphosphate, rock phosphate, &c., in each of which the water soluble and citrate soluble proportions differ. Chemists are called on to ascertain the availablity of plant foods in different forms of combination, and to give information

regarding the utilization and value of all these various materials under different conditions of soil, climate, and crops. Enormous progress has been made in the solution of such problems, but much more must be done before any final solution can be reached. Sulphate of ammonia and nitrate of soda, for example, both have a high value; but on an acid soil nitrate of soda should give better results; on a neutral soil they may be of equal value, while on a soil tending to alkalinity, sulphate of ammonia would probably be better. These generalities are, of course, influenced by the economic consideration as to which gives better value for money expended. The chemist is also called in to assist in determining the formulae of mixed fertilizers which should be used for different crops under varying conditions of soil and climate. Fertilizer experiments in field and pots, and chemical analyses of soils and crops are some of the means by which this information is obtained.

The chief essentials for the maintenance of soil fertility as discovered by the chemist may be summarized briefly as follow:—

First.—To maintain the supply of nitrogen and humus in the soil by the use of manure as far as available, and the ploughing in of a legume crop supplemented with the use of such nitrogenous fertilizers as may be found profitable.

Second.—Maintenance of the phosphoric-acid content of the soil, or correction for the deficiency in phosphoric acid, by the use of phosphatic fertilizers, supplemented by the saving of all possible plant food in manure and plant residues.

Third.—Correction of the acidity of the soil, if there is any acidity injurious to the crops grown, by the use of lime or limestone. Lime, limestone, marl, and gypsum are also used for the improvement of the texture of some heavy soils, and for supplying lime to certain crops which need a quantity of lime, when grown on soils low in lime.

Fourth.—If there is a deficiency of potash in the soil, potash fertilizers should be used to correct this deficiency.

Fifth.—All possible losses of plant food should be prevented. Manure should be saved carefully, or the animals fed as much as possible on the land to be manured, and crop residues utilized as far as practicable.

Sixth.—The practice of the correct cultural method for the particular crop and district or locality, as undoubtedly rotation of crops and fallowing have important bearings on the maintenance of soil fertility.

A full discussion of the contribution of the chemist to the maintenance of soil fertility is impossible in a few pages, but the foregoing should give a general outline of the immense amount of work involved.

DAIRY CHEMISTRY.

F. Penman, M.Sc., Assistant Research Chemist.

Very few Victorians, even among those closely associated with dairying, realize the importance of this industry to the State. Dairying takes a leading place among our primary industries from the financial point of view, and when it is remembered that the industry gives employment to about 46,000 Victorians, there is no further need to stress its value as a national asset.

The chemistry of dairying really starts with the study of the soil, since it is from the soil that crops necessary for feeding cows are obtained. In this connexion, most of the efforts of the chemist have been directed towards soil improvement, by such methods as top-dressing, with a view to enriching pastures. Chemical analysis of pastures and fodders is necessary in preparing a suitable ration. The question of mineral deficiencies of stock foods is at present engaging widespread attention from experts in animal nutrition, and this subject is of special importance in feeding cows, because considerable quantities of minerals are carried away in the milk, and these must be continually made good.

The Composition of Milk.

Milk is, of course, the starting point for the manufacture of all dairy products. The application of scientific methods to the study of milk has shown that normal milk contains more than 20 individual compounds, some of which are solids, some liquids, and some gases. The chief component is water—about 87 per cent. on the average. Milk is designed in the first place for nourishing the young calf, and all animals need a large amount of water to carry on their bodily functions. The water in milk supplies this need and also carries the milk solids in easily digestible form.

The solids of milk consist of fat, nitrogen compounds or proteins, milk sugar or lactose, and salts. Fat is present in milk, not in solution, but suspended in the form of very small transparent globules, each about one ten-thousandth part of an inch in diameter. It is estimated that in one drop of average milk there are about one hundred million of these tiny fat globules. Milk fat has a high food value, and the percentage of milk fat is the basis for valuing most dairy products for commercial purposes. The amount of fat in average milk is just under 4 per cent.

The proteins or nitrogenous bodies in milk constitute a little over 3 per cent. on the average. Proteins are continually being broken down in animals as the result of bodily activity and, therefore, a certain amount of protein must be supplied to the body each day. A typical protein is white of egg or egg albumen. The chief protein in cow's milk is called casein. This is rather a special type of protein because, in addition to nitrogen, which all proteins contain, it has also a certain amount of phosphorus. Casein is present in milk as a compound with lime, and is suspended in milk in the form of extremely small gelatinous solid particles. Another milk protein called milk albumen is present to a small extent only. It is obtained in Victoria on a small scale as a by-product in the manufacture of milk sugar.

Lactose or milk sugar is dissolved in the water of milk, the amount present being usually about 5 per cent. This is a carbohydrate, the third main type of food, fat and protein being the two other types. Thus milk contains all three major food constituents. Lactose closely resembles ordinary sugar, but it is not so sweet, and it does not dissolve so readily in water. Lactose in milk is very important in its relation to dairy products, especially butter and cheese, because by the action of certain bacteria, lactose is easily converted into lactic acid, and this acid has a very important effect on the processes involved in the manufacture of butter and cheese. Lactose is usually made from the whey obtained from the manufacture of cheese or of casein. It is purified, dried, ground and sifted, the final product being something like flour. One factory in Victoria produces about 200 tons of this material per annum. Lactose is used chiefly in the preparation of foods for infants and invalids.

The salts present in milk include compounds of lime, magnesia, soda, potash and phosphorus, all of which play their special part in the growth and maintenance of animal life, lime and phosphorus being of special importance to young animals because of their contribution to the formation of bone. There are several other compounds normally present in milk in small amounts, which have little practical interest, but among them is an exceptional group of substances called "accessory food factors" or vitamins. Without these, even if satisfactory amounts of the other food constituents are given to animals, proper growth cannot take place. The vitamin most prominent in milk is called "fat soluble A," because it is concentrated in the fatty portion. The other vitamins are also present in milk.

It is on account of the high, and more or less complete, value of milk as a food that many kinds of bacteria find it an altogether excellent medium in which to grow. Such bacteria constitute the living population of milk, and it is as the result of their action on the compounds of milk already described that most of the changes in milk occur, and to them must be attributed many of the problems which arise in the dairy industry. Some bacteria are desirable in milk—for instance, the lactic group which produces lactic acid from lactose; and some are very undesirable, having their origin in dirt and disease, and causing fermentation, gas production and objectionable flavours in milk and dairy products. Fortunately, the lactic group grows very vigorously once it becomes well established, and under favourable conditions is able to choke out the undesirable organisms. Even in milk drawn from the cow under very clean conditions a certain number of bacteria are present, and the rate at which they multiply under favourable conditions is truly marvellous. This growth can be checked by keeping milk or cream cool, or the organisms may be killed by heating the liquid to a fairly high temperature for a time. This process is called pasteurization, and has come to be regarded as essential in many dairy operations. It is very effective, but should not be regarded as a "cure-all." It cannot kill all types of bacteria, and does not remove any objectionable products which may have accumulated while bacteria were thriving.

Let us look at some of the changes which take place in milk. If it be left to itself at ordinary temperatures it gradually turns sour. What actually happens here is that lactic bacteria grow in the milk and feed on the lactose, converting it to lactic acid, which gradually accumulates.

When there is about one-third of one per cent. of lactic acid, the milk begins to develop a sour taste, and is said to be "on the turn." As still more acid accumulates, the casein is broken from its combination with lime and settles out as a curd, carrying with it the milk fat. The milk is then said to be sour, the taste being due to lactic acid, which may be present finally to the extent of about one per cent.

A somewhat similar process occurs in cheese making, but here the casein is caused to separate by adding rennet to milk in which a certain amount of lactic acid has developed. Rennet is an extract from the stomachs of calves, and is familiar in the form of junket tablets. The rennet causes a coagulation of the lime-casein compound, and this, as before, entangles the milk fat and separates as a curd, leaving the whey which contains most of the lactose and albumen, which can be extracted from it. The curd is separated, dried, milled, salted and pressed, and finally matured to cheese. Cheese is a concentrated food containing about 35 per cent. each of water and fat, about 25 per cent. of protein, and about 1 per cent. each of lime, phosphoric acid, and salt.

Other processes by which the food value of milk is concentrated are the making of cream and of butter, which concentrate the milk fat. Cream is made by a mechanical separation of the lighter fatty portions of milk, either by gravity or centrifuge, leaving the heavier skim milk. Separator skim milk should not contain more than one-tenth of one per cent. of fat. In Victoria there must be at least 35 per cent. milk fat in material sold as cream. In butter manufacture the concentration of milk fat is carried still further. Butter is made from cream by neutralizing any excessive acidity of the cream, pasteurising it to control bacteria, cooling it and then churning to make the fat globules adhere to one another and build up butter granules. In Victoria, butter must contain at least 80 per cent. fat, and not more than 16 per cent. water. The butter milk or watery part of the cream, which is washed away from the churn contains only about one-fifth of one per cent. fat. Butter is quite our most important dairy product, a large proportion of the milk produced here being used for its manufacture.

The Necessity for Cleanliness.

A question for searching inquiry has arisen in connexion with our butter exported to England last season, some of which was said to suffer a marked deterioration in quality. Last season's shipments were the first made under the regulations prohibiting the use of boric acid as a preservative in butter imported into England. The absolute necessity for cleanliness at all stages in the manufacture of dairy products cannot be over emphasized.

Some of our factories have improved greatly in this direction recently by the installation of hygienic equipment, some of which, especially that lined with glass enamel, is delightful to operate and keep clean. The dairy farmer must also play his part in producing clean milk. Some of our factories filter a measured quantity of each supplier's milk through a little cotton pad which collects any dirt. These pads are dried and periodically posted up at the factory with the suppliers' names underneath. A careless dairy farmer may not be very distressed if he is told that his milk contains 20 million bacteria per cubic centimetre,

but if he sees his pad with a very dirty stain and his neighbour's practically clean, it brings the matter more forcibly to his attention. One or two careless suppliers may make a great difference to the product of a factory, and it is only fair to the other suppliers to adopt some test like this. Of course, this test is only a measure of the visible dirt, and gives only an indication of how much invisible dirt, that is, bacterial infection, may be expected.

Numerous other tests have been developed to measure the quantities of various constituents present in dairy products, to detect adulteration, to measure the number and to show the kind of bacteria present, and so on. Of these tests, the Babcock test for fat percentage is the most widely used. Nearly all factories use it, and herd testing associations use it to determine the amount of fat given by each cow, thus enabling owners to cull their herds and get rid of unprofitable members. This is steadily leading to an improvement of dairy herds.

Some of the Products from Milk.

Many other aspects of the subject may be only lightly touched upon. The manufacture of condensed, concentrated and powdered milks consists in the removal of water by evaporation, giving a product which keeps better and costs less to transport than milk. The manufacture of milk foods for infants is a special study involving the alteration of cow's milk to make it resemble human milk as closely as possible. The chief differences are that cow's milk contains more than twice as much casein as human milk and rather less lactose.

Casein presents an interesting story. Some of its properties have already been described. It is made from skim milk either by letting it sour or by adding rennet. In any case, as was explained previously, casein is coagulated and separated as a curd, in this case with very little fat, because skim milk contains only a trifling amount. The curd is dried and ground to a fine yellow-white powder. The variety of uses to which the material is put is astonishing. Some of it is used as an adhesive in paints, glues, and as a glaze for paper. Some is used in medicinal preparations and body builders.

Most of our casein goes to Japan and Europe. Rennet casein is used very widely to make substitutes for bone, ivory, ebony, tortoise shell, &c. It is everywhere—in buttons, fountain pens, combs, pipe stems, ornaments, and as insulating material in most of the radio sets in use to-day.

INSECT PESTS.

By C. French, Jun., Government Entomologist.

He is an optimist indeed who expects to grow plants or fruit trees without having to contend against pests. It is only by an unending battle—by spraying, fumigating, and dusting, by cleaning and swabbing —that we can get the best results from any crop.

Emphasis must be laid on the fact that a pest is far easier dealt with if tackled in its early stages. Pests often increase with great rapidity, so that if left for some days the work of eradication is very difficult. Prompt attention pays.

The present season promises, unfortunately, to be favorable for insect pests in the flower, fruit, and vegetable garden, glass-house, bush-house, and fernery.

Light-Brown Apple Moth.

One of the commonest and most destructive pests of flowers and fruit trees, which is exceptionally widespread this season, is the Light-brown Apple Moth. Every lover of roses, asters, dahlias, or carnations has often noticed greenish caterpillars curled up in the leaves, and in the buds of flowers. The caterpillars, when fully grown, are about 1 inch in length. They are very active, and have the habit of dropping to the ground by a silken thread and hiding in crevices when disturbed. The moth is yellowish-brown, measuring three-quarters of an inch across the wings. It deposits its eggs on young flower buds, and they hatch in a short time, the caterpillars immediately boring into the flower buds or making holes in small apples.

When trees or plants are affected by these pests, they should be sprayed with arsenate of lead.

Looper Caterpillars.

During the last few weeks many fine cypress or cupressus hedges have been attacked by looper caterpillars (so called from their habits of curling up the body into a loop when walking).

Nearly all these caterpillars are stick-like in form and colour, and most of them assume an appropriate attitude when at rest. The majority feed at night, but when daylight comes they take a firm hold upon a twig with their two pairs of pro-legs, and stretch out at an acute angle. In some suburban gardens these caterpillars have been present in hundreds on hedges. They eat the young shoots, causing brownish patches to form on the trees. Fortunately, by the arsenate of lead spray, caterpillars can easily be kept in check.

Stick-Case Moths.

This season has been an exceptionally favorable one for small Stick-case Moths. As many as 200 were collected on cypress hedges at a garden in Caulfield. These insects, like the loopers, do much damage to hedges, especially cypress hedges.

Painted Apple Moth.

During the warm weather the caterpillars of the Painted Apple Moth have become numerous. They are very destructive to plants of all kinds—roses, carnations, pansies, vegetables, and the fruit spurs and leaves of fruit trees are destroyed by them. These caterpillars have loose tufts of hair on their backs, and are greyish in colour. It is a native insect, and has become one of the worst pests the gardener and orchardist have to contend with.

Red Spider.

The hot weather is responsible for the spread of many destructive pests, and amongst them may be mentioned the Red Spider, a pest well known to lovers of flowers, vegetable growers, and orchardists.

It belongs to the Acarids or Mites, and is, therefore, strictly speaking, not an insect. The eggs of this Mite remain both in the soil and on the plants during the whole season. The young usually feed on the under surface of the leaves, and cover them with a fine web.

In flower gardens, dahlias, rhododendrons, asters, pansies, and other flowers and shrubs are attacked. In vegetable gardens French beans are often so thickly infested with these pests that the leaves turn a sickly yellow colour and shrivel up. Tomato, melon, and vegetable-marrow plants are also attacked by them.

Plants, &c., should be well watered in the summer, as when once the ground is allowed to get dry they are liable to be attacked by the Red Spider. To control Red Spider nicotine sulphate, or black-leaf 40, is used at the rate of 1 oz. to 5 gallons of water; to this add a little soapy water, and thoroughly spray the underside of the leaves.

All stakes, after having been used for tomatoes, &c., should be treated with boiling water before being used again; by this means the eggs of the spider will be destroyed.

Pumpkin Beetle.

Another vegetable pest, viz., the Pumpkin Beetle, is appearing in fair numbers, and as the weather gets warmer these beetles cause much concern to growers of pumpkins, melons, and cucumbers.

A very common mistake is made by confusing this pest with the beneficial Ladybird. The distinctive feature about the Pumpkin Beetle is that it is elongated in shape, while the Ladybird is almost round.

Spray with arsenate of lead, at the rate of 1 lb. to 25 gallons of water.

Tomato Weevil.

One of the worst pests of the tomato is the Tomato Weevil. It is a small greyish-brown beetle with a prominent snout. The grub or lava is a light pea-green colour, and about a quarter of an inch long. In the daytime it is usually found in the soil a few inches from the surface. These larvae often feed in the daytime as well as at night. By eating the stems through at the base they cause the tomato plants to fall to the ground. Poisoned baits or arsenate of lead are used with excellent results against them.

Millipedes.

It is some years since Millipedes, hard-shelled form-like animals, often called "thousand legs," were so numerous as they are at present in many suburban vegetable gardens. When these pests are disturbed they move very rapidly. They attack, principally, the roots of plants. Usually they are associated with the presence of manure which contains considerable decaying vegetable matter, and are abundant in damp places. Several very reliable remedies can be used, viz.:—Clift's Manurial Insecticide, or pieces of vegetable dipped in paris green, or in the dry arsenate of lead, and worked into the soil.

Fern Aphids.

In the green-house or fernery, Fern Aphids are to be found on the young fronds of maiden-hair and other ferns. They cluster around the top of the young fronds and suck out the sap, causing the fronds to become dark and to die off. If the plants are thoroughly sprayed with nicotine sulphate, or black leaf 40, the insects will be destroyed.

Mealy Bugs.

Other troublesome pests in glass-houses, &c., are Mealy Bugs. These are frequently found on begonias, ferns, and other plants. To keep them in check, spray with tobacco water or benzole emulsion.

Black Thrips.

One of the worst pests of ferns is the Black Thrips, closely allied to the Rose Thrips. These are found on the under-side of the leaves. When the leaves are attacked by these pests they turn yellow and die. Thoroughly spray the under-side of the leaves with tobacco sprays, such as nicotine sulphate, or black leaf 40. Benzole emulsion is also recommended.

Aphids.

During the present season Aphids of all kinds, especially Rose, Carnation, Peach, and Citrus Aphids, have been exceedingly numerous. These are controlled by nicotine sulphate, black leaf 40, oil and nicotine sulphate, and other sprays.

Scale Insects.

Scale insects are usually found in gardens on various plants, one of the commonest being the Rose Scale. It is a white scale, which is very common on roses, loganberries, &c. At times the scales are so thickly clustered that the stems look as if they had been whitewashed. Soon after being hatched, the young commence to suck the juices from the plants on which they are living, thus making the plants become sickly. As the young scales are now hatching, it is advisable to use tobacco sprays. After pruning, use red oil or lime sulphur. All prunings should be burnt.

Take-all Grubs.

Quite a number of bowling greens and lawns have suffered this season through the depredations of the "Take-all grubs"—a dark-greenish grub about 2 inches in length. They come up at night to feed, and eat the young growth, causing bare patches on the lawns.

An excellent plan to get rid of these caterpillars is to spray the lawns or bowling greens just before dusk, with arsenate of lead.

Cutworm Moths.

Cutworm moths have been very numerous recently, and it is almost certain that at any time now the destructive cutworms will appear in vegetable and other gardens. They are most destructive, and attack tomatoes, beans, onions, cabbage, potatoes, &c. The caterpillars hide amongst the debris and soil during the daytime, and at night come to feed. They are easily destroyed by poisoned baits or by spraying the plants with arsenate of lead.

Pamphlets on Cutworm control can be obtained from the Department of Agriculture, Melbourne, free, on application.

Rutherglen Bug.

The Rutherglen Bug is a well known pest of flowers, fruits, and vegetables. It deposits its eggs amongst rubbish and weeds, or under the soil. Tomatoes, beans, peas, potatoes, and other such vegetables are its favorite foods. They also cause much damage in orchards to soft fruits, grapes, &c. It is rather difficult to control them, as they are often found in paddocks adjoining an orchard. The phenyle spray has been used successfully against these insects which generally make their appearance in the hot or warm weather in fields near orchards.

Woodlice.

Woodlice are not, strictly speaking, insects, but as they cause considerable damage to vegetables they must be mentioned here. They are very destructive among carrots, turnips, cabbage, and other vegetables.

The common woodlouse, or slater, is mostly nocturnal in its habits, retiring during the day under logs, stones, old bags, and, in fact, any kind of hiding place that is accessible, and coming forth in the evening to feed.

Snails and Slugs.

Snails and slugs also cause much damage to plants, &c. If calcium arsenate baits are used these pests will soon be completely eradicated. This chemical is obtainable from any of the seed shops.

OUR INSECT FRIENDS.

By G. T. Levick, B.Ag.Sc., Assistant to Entomologist.

Insects, as a general rule, are regarded as one of man's worst enemies; in fact, scientists have predicted that man will eventually be exterminated by these pests, which, world-wide in their distribution, already outnumber, both in species and in individuals, any other division of the animal kingdom.

However, with the advance of entomological science, entomologists are adopting the old adage "Set a thief to catch a thief," and are using one species of insect to exterminate another. Although the first successful experiment on these lines, the use of the Australian ladybird to combat the Cottony Cushion scale in the orange groves of California, was undertaken about forty years ago, little progress was made until comparatively recently, and the science of biological control may be said to be in its infancy.

The Introduction of Insects.

There is little doubt that in the future all the major entomological problems will be solved by the utilization of beneficial insects, and some success has been achieved, in New Zealand, in the extermination of noxious weeds by this means, and also in Queensland, where insects have been introduced in the hope of killing out prickly pear.

In New Zealand a wasp is being used to prevent the spread of the furze, otherwise known as gorse (*Ulex europæus*). The young of the wasp eats the interior of the seeds in the little capsules, so that when the heat of the day causes a sudden bursting of pods, instead of seed being flung out a new generation of the seed-eating wasp is scattered forth.

This, of course, does not interfere with vegetative reproduction, and furze hedges may be propagated from cuttings, but it does effectively prevent the rapid spread of the plants by seed, eliminating the necessity for continuous grubbing, which is the great drawback in the use of this type of hedge.

The Commonwealth Entomologist (Dr. Tillyard) has just returned from Europe, where he has been searching for insects which are likely to be of value in controlling St. John's Wort, which is rendering valueless thousands of acres of land in the north-eastern portion of our State, and against which all mechanical and chemical remedies have proved of limited value.

Dr. Tillyard's intention was to obtain, if possible, insects which will attack the roots; others which will be stem-borers, leaf-eaters, and seed destroyers, and it is hoped that the combined result of these will overcome the most determined resistance on the part of the weed.

The idea of liberating insect parasites to attack the various pests of the orchard and garden seems to have taken strong hold on the popular imagination, but the problem is not nearly so simple as many seem to think.

For instance, a certain native beetle, a serious pest in orchards, is found, in some districts, to have a parasite attacking it. This discovery does not, however, get us very far on the road to controlling that beetle, because the two, parasite and host, have been living in association for, probably, a very long period, and still the beetle remains a serious pest in that district. The reason for the non-control of the pest by the parasite may be that the beetle multiplies faster than the parasite, which may itself be checked by secondary parasites. This is more or less true of all native parasites, and the numbers that can be artificially reared would be so compartively few that they could not materially affect the position.

On the other hand, if we import a parasite from another country, it arrives here free from secondary parasites, and if the climate and other conditions are favourable, it may go ahead without check, and be a valuable aid in controlling the pest.

Thus we see that to use insects successfully in this manner, it is essential that either the parasites be brought from places where they actually do control the pest in question, or that they be given exceptionally favorable conditions to work under when they arrive here.

Any attempt to upset the balance of nature must be undertaken with the greatest of caution, and it may take many years before the study of the interaction of insects to their environment has reached such a stage as to enable us to predict with any accuracy what the effect of any introduced insect will be.

Domesticated Insects.

Insect friends of man include, as well as those which prey upon their kind, those insects which produce material of commercial value. Some of these are domesticated, some semi-domesticated, while others again are left, more or less, in the wild state. The silkworm moth is the best example of a domesticated insect. So long has it been bred and looked after by man that the moths have become incapable of flight, and the species would not survive a single generation without man's care and attention.

The ordinary hive-bee, though it thrives best under artificial conditions, and may be classed as a domestic insect, can, and frequently does "go wild," and is able to live and breed under natural conditions.

Of the more or less wild forms used for commercial purposes we have the Lac and Cochineal insects of the tropics, and the use of the so-called "ant eggs" as food for cage birds.

The cochineal insects are of special interest. They are found in Central America. Their food is a species of prickly pear, and it is from the expressed juice of the bodies of these insects that the cochineal colouring matter of commerce is made. A species of this insect has been introduced to attack the prickly pear pest in Queensland, but as it lives on only one species of pear only moderate success has attended its introduction.

Predators and Parasites.

There are two types of insect which prey on their fellows—predators, which capture and eat other insects, and parasites, which live more or less on or in a single individual of the host insect.

Ladybirds.

Examples of one or other of these types may be found in nearly all the different orders of insects, though the only insects recognized by the majority of gardeners as their friends are the ladybirds and perhaps the praying mantis; and often in its young stages the ladybird is mistaken for a pest, both by gardeners and orchardists.

A case came under notice recently of an orange grove which was heavily infested with scale insects. Large numbers of ladybirds collected to feed on the scales, and in due course the young or larvae of the ladybirds appeared and joined in the good work.

The orchardist, however, thinking a new pest was attacking his trees, very successfully sprayed them with a contact insecticide, exterminating almost all of what were really his best friends.

While the best known ladybirds are red with black spots or stripes, there are many species of various colours, such as brown, metallic blue, blue with yellow spots, and other colours. All species occurring in Victoria are beneficial. The ladybird and its larvae live on scale insects, aphides and mealy-bugs.

Syrphid Flies and Lace Wings.

Of the other native insect predators, the most useful are probably the Syrphid Flies and the Lace Wings. Only the larvae of these insects are useful, the adults not feeding to any extent.

The syrphid or hover flies may be seen almost everywhere on a hot day, hovering quite motionless for a second, then darting with remarkable speed for a few yards. They are fairly conspicuous, varying in size from about the size of a house fly to that of a bee; many species have bright yellow and black striped abdomens.

The larvae of these flies are greenish-grey maggots, very active in their movements, and they cause great havoc among soft-bodied insects, particularly the Woolly Apple Aphis. The lace wing larvae have similar tastes, and are most voracious feeders. The lace wing is remarkable in that it lays its eggs each on a long stalk, nearly half an inch in length. This is apparently a necessary precaution owing to a cannibalistic tendency on the part of the newly hatched larvae or "aphis lion," the first one out of the shell being quite capable of eating all the rest of a group. As it is, he devours his own egg-shell, and, creeping down the stalk, fails to find the other eggs high above him.

The Ant Lion.

The little "ant lion" is a close relative of the "aphis lion," and has very interesting habits. He buries himself to the neck in a funnel-like excavation in the soil, and patiently waits for an ant to tumble in, whereupon he quickly seizes his victim, and shortly afterwards flings the less edible portions out of the hole. Should an ant, however, be nimble-footed enough to check the fall, the "lion" is quite capable of flicking a few grains of sand at him, and this generally precipitates him into the formidable mandibles of the ant lion.

Tachnid Flies.

Most of the true parasites belong either to the Wasp family or to the true flies or Diptera.

The most important of the parasites belonging to the Diptera are the Tachnid flies. These flies lay their eggs on caterpillars of various kinds, and the young maggots, on hatching, burrow into the caterpillar, and live on its substance until fully grown.

The Tachnids are very similar in appearance to Blow Flies, to which they are fairly closely related. The superfamily, Muscoidea, includes species showing all stages of parasitism, from the purely vegetable and excremental feeders, the house flies, to the blow flies which breed in both vegetable matter and animal matter both living and dead. Some species, such as the sheep blow fly, will attack living animals, and so may almost be described as parasites, while the Tachnids are true parasites, living only on living insects.

Ichneumons, Braconids and Chalcids.

The Ichneumon wasps are numerous and widespread. They are fairly large, slender wasps with long ovipositors, or egg layers, and may frequently be seen flying around lights on summer nights. They are parasitic on caterpillars of various kinds, particularly cutworms. The eggs are laid under the skin of the caterpillar, and, on hatching, the young grubs feed on the caterpillar, reaching maturity about the time their host would normally pupate.

Two other families of wasps of great importance in the control of insect pests are the Braconids and the Chalcids. The members of both these families are of a much smaller size than the Ichneumons.

These wasps are parasitic on caterpillars of all sizes, hundreds of the tiny wasp grubs growing to maturity in a large caterpillar, such as the larvae of the Wattle Goat Moth, while the smaller Dried Fruits caterpillar may only be sufficient for one or two.

Small insects, such as scales and aphides, are parasitized by these wasps, and it was to control the Woolly Apple Aphis that the tiny Chalcid, *Aphelinus mali,* was imported into Victoria about four years ago. This chalcid is extremely small, being scarcely visible to the naked eye. From a consignment from Western Australia, and one from New Zealand, we obtained about a dozen individuals of the wasp. They were bred within cheese-cloth covers on trees badly infected with Woolly Aphis at the Burnley Horticultural School. From there they spread throughout the Burnley Orchard, and so successfully have they controlled the aphis there that no sprays for this pest have been found necessary since.

From Burnley the parasites were distributed to all the apple-growing centres in Victoria, being carried while in the pupal or resting stage.

The influence of the Aphelinus on the Woolly Aphis varied remarkably, not only from district to district, but from orchard to orchard. In districts as widely scattered as Pakenham, Bacchus Marsh, Fryerstown and Shepparton, growers have had remarkable success, the parasites cleaning up patches that had never been clean before, while on other orchards in the same district repeated efforts have failed to establish the wasp.

It is difficult, at first sight, to account for these variations, but a close investigation would, no doubt, reveal differences in situation, exposure to winds, etc., or differences in the treatment of trees which would account for the behaviour of the parasites.

FOUL BROOD IN BEES.

By J. S. Eagland, Apiary Inspector.

One of the commonest diseases among bees in this country is American Foul Brood. As the name implies, it attacks the brood—that is, the larva and pupa. It is a very deadly disease, and has attained serious proportions in certain districts in Victoria.

The Department of Agriculture at the present time has eighteen districts under observation for foul brood, and when I mention that they are scattered from near the South Australian border to East Gippsland, it will be realized that, if not checked, the disease may soon overrun all the bee-hives of the State.

Investigation in the eighteen areas referred to revealed that 9½ per cent. of all hives there were infected with the disease. But when it is pointed out that in those apiaries consisting of from ten to twenty hives a disease infection of 25 per cent. was found, while in those consisting of under ten hives there was a 75 per cent. infection, it will be realized that the small apiarist can be the most serious menace to the industry. I would, therefore, urge on those people who may have only a few hives to give them a thorough examination, and if there is any sign of foul brood, to write to the Department of Agriculture for a free pamphlet on the subject. This pamphlet contains instructions which, if followed, will enable one to suppress, in the early stages, the disease in one's own hives, and prevent it spreading to neighbouring apiaries.

Further, any suspicious cases should be immediately reported to the Department of Agriculture.

How the Disease is Spread.

So that the reader may be the better able to follow my description of foul brood, I shall first describe the ordinary life cycle of the honey bee in its larval stages. Preparations commence by the nurse bees cleaning and polishing a cell in the comb; in this cell the queen lays an egg, which takes three days to hatch into the tiny grub or larva. The larva grows at an enormous rate, and, therefore, must be fed very heavily by the nurse bees. In six days from the time of hatching, the larva pupates, and remains in the chrysalis form for a period of twelve days, when it emerges a perfect honey bee, ready to take its place in the routine of the hive.

The actual disease, which is of a highly infectious nature, is caused by a germ or bacteria named *Bacillus larvae.*

The spores of this bacteria may lie dormant in honey from a diseased hive, or in a container which has been thrown out on the rubbish heap, and in this way may reach the young larva.

Immediately the larva pupates, conditions become favorable for the growth of the germs, and they multiply rapidly, killing the pupa in a very short time. The germs then produce spores, or seeds, so that, when they die, the spores remain until they in turn are in a suitable place to develop.

The nurse bees, when cleaning out the dead brood, are liable to carry the germs and their spores from one cell to another, and so rapidly infect the whole of the hive. The spores also contaminate the honey of the hive, so that, should any honey from a diseased colony be secured by other bees, their brood in turn will also develop the disease.

Honey should never be handled, strained, or extracted in the open air or anywhere else where bees are likely to get access to it.

Personally, I think the old method of straining the honey and putting the combs out for the bees to clean up has been the greatest cause of spreading this disease in Victoria. Unfortunately, this method is still practised by some people having only a few hives, and who will not incur the expense of purchasing a honey extractor.

How to Recognize the Disease.

To be able to identify disease, it is necessary to know the appearance of healthy larva, and this knowledge can best be acquired by actual examination of the brood. Normally, larvae are pearly white in appearance, and lie curled in a circle in the base of the cell. When the larva pupates, it changes its position, and then lies on its back along the bottom wall of the cell. While in this position, the cell is capped by

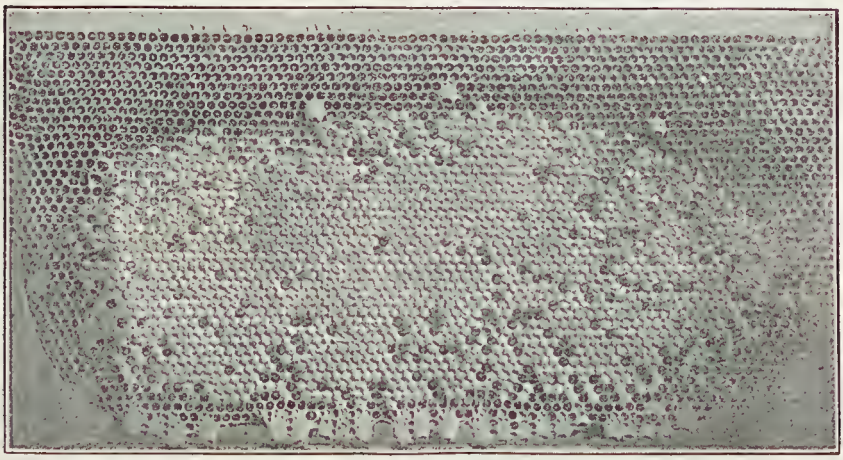


Fig. 1.—Comb of Healthy Brood; Queen's Cell also Shown.

the nurse bees, and the pupa in about six or seven days begins to change colour, gradually darkening until it takes on its natural markings shortly before hatching.

In the case of disease, usually the first sign is that the cappings of the brood, instead of being convex or raised, and of a dirty straw colour, change to a dirty-brown or coffee colour, and gradually become sunken, and very often contain a few small irregular holes.

If the capping of a diseased cell be removed one will find that the pupa, instead of being white, is of a yellow or brown colour. Once the brown stage has been reached, it will be found that the pupa is quite sticky, and if a match be inserted, will draw out for about half an inch. This stickiness or ropiness is the most dependable method of identification, the so-called foul brood smell not being discernible by the average person until the disease is so far advanced as to be a menace to the whole neighbourhood.

How to Treat Foul Brood.

When a beekeeper has an odd case of disease, much the safest treatment is to sulphur the bees in the evening, and burn everything by placing the complete hive, without opening it, on a fire. But it must be remembered that honey will not burn, and the whole effort may be wasted and a bad outbreak of disease result, unless the burning be done in a hole dug in the ground. If this be done the honey will run through the fire, and later can be buried.

It is also essential that the work be completed and the hole filled in the same evening. Observance of these precautions is essential for success in treatment.

The practice of buying old combs and equipment is also decidedly risky; generally, it will pay better and is much safer to use new frames fitted with full sheets of comb foundation.

Should foul brood be present in many hives in the apiary, burning will be too expensive, and the best thing to do will be to sterilize the equipment, so that it may be once more put into use.

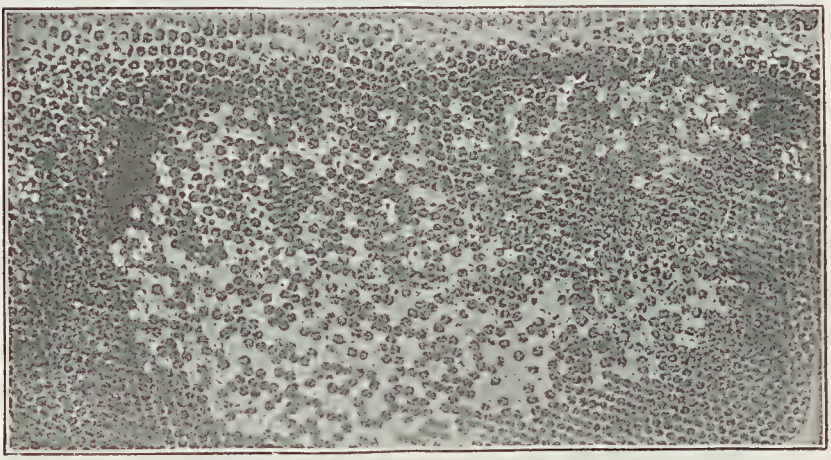


Fig. 2.—Comb of Diseased Brood showing Flat, Sunken, and Perforated Cappings.

On no account should one try to cut out the diseased combs only; this will be found to be absolutely ineffective.

To treat a colony successfully, the work must be done at a time when no bees are flying, that is, in the evening.

If sufficient bees remain in the colony to be worth saving, shake them from the combs in front of an empty hive which has been in a similar position to that of the diseased colony. After the bees have been in the empty hive for 24 hours, remove any comb they may have built and burn it; then place them in another hive, and give them frames fitted with full sheets of foundation on which they may make a fresh start.

An old bag should be placed in front of the empty hive on which to shake the bees, and when they have all run in, the bag can be burned; in this way any honey and fragments of comb which may have dropped during the shaking will be destroyed.

After removing the bees, the combs and frames should be at once placed in a large vessel of boiling water, to which a few pounds of washing soda has been added. The frames should be kept in the water, which must be kept boiling, for at least 30 minutes, care being taken that they are kept under water the whole of the time.

The hive bodies, covers, and floorboards can be treated in the same manner, and will then be quite safe for use again. However, a much easier method of treatment, in the hands of a careful operator, is a thorough scorching of the hives, &c., with a blow lamp.

It must be remembered when treating foul brood that all work must be completed the same evening, as any equipment not treated would be worked over by the bees the next morning, and a fresh outbreak of the disease started.

Even a fragment of comb or one drop of honey spilt on the ground would be sufficient to undo all the work of treatment. All boiling of diseased combs, &c., must always be done in a room that is bee-proof; otherwise the risk of spreading disease is greater than the value of the equipment saved.

I have had many inquiries regarding the treatment of foul brood combs with sterilizers, but in Victoria the cost of alcohol-formalin solution makes this method prohibitive. Other methods in use in the United States of America are still only in the experimental stages, although promising success in the future.

Precautions Advised.

In conclusion, I would advise apiarists, particularly those having only a few hives, to take the following precautions:—

To study healthy brood so that they will know its natural appearance.

To make themselves familiar with the symptoms of foul brood.

To examine their colonies at least twice yearly for foul brood.

At no time to leave honey or combs lying about; they may be the means of spreading disease.

To report every instance of suspected disease to the Department of Agriculture, at the same time sending a specimen of the brood.

When treating disease, be very careful that absolutely no honey is spilt; one drop may do as much damage as a hundredweight.

VITICULTURE—SEASONAL HINTS.

By F. de Castella, Government Viticulturist.

In taking seasonal viticulture as my subject, I am certainly giving myself ample scope, since several vineyard operations will need attention at the moment. My time limit*, however, permits only the briefest reference to most of these, for I desire to deal particularly with two points which I consider to be of special importance; firstly the downy mildew menace, and the measures necessary to ensure protection; and secondly, the very real advantage to be derived from vineyard sulphuring.

Before dealing with these, the ordinary routine operations must be briefly mentioned; these can be grouped under the two headings, tillage and summer pruning.

The former demands attention in the shape of the summer cultivation by which is maintained the dust mulch so vitally necessary to retain soil moisture. The depth of these summer cultural operations depends on that of the winter ploughing. If this was deep and early as it ought to have been, and as is now the usual practice in our best irrigated vineyards, the summer workings can with advantage be fairly deep also; obviously, the deeper the mulch the more efficient it is. If the winter ploughing was 8 inches deep, summer workings may be 5 or even 6 inches deep, otherwise they must be shallower, so as not to cut functioning roots. The roots of the vine can be cut with impunity in winter, during the dormant period, but any interference with them during the growing season is injurious to the fruit. The number of workings and their timing depend on various circumstances. After rain the scarifier must be employed to break the crust which would, otherwise, spoil the mulch and render it ineffective. Such work must be judiciously timed; remember that the presence of newly-worked soil increases the danger from frost and the liability to fungous pests.

Irrigation and tillage are to a great extent inter-dependent, the execution of the latter being regulated by the timing of the former, which is not altogether under the control of the vineyard-owner. Irrigation is a vast subject. The golden rule is to irrigate seldom, but to ensure the penetration of the water to a sufficient depth, and to retain as much as possible by thorough cultivation. The tendency in the best worked irrigation vineyards is the application of less water but more thorough cultivation.

Manuring should not really concern us at this time of year, as it ought to have been attended to some time since. Though there will be some response for a few weeks yet, winter application is always the best. The vine takes nearly all its phosphoric acid and most of its nitrogen during the big rush of growth before blossoming time.

Summer pruning may be said, in a general way, to always weaken the vine. Occasionally, with over vigorous vines, weakening may be desirable, but in the vast majority of cases the contrary holds good. Suppression of growing parts does not concentrate strength in the

* This article was delivered as a "wireless talk" on the 22nd October.

remaining portion, as is sometimes erroneously thought, but has absolutely a reverse effect. The deferred action on vigour and yield in the following and subsequent seasons is more pronounced than during the year of its execution. It follows that injudicious and excessive summer pruning can become a potent cause of sterility and decline.

The different operations vary in severity. Disbudding is the most generally useful; it diverts the growth into fewer and well placed channels, by suppressing undesirable ones, whilst, as yet only small sprouting buds. It is, as a rule, desirable and sometimes necessary, its weakening effect is trifling.

Stopping, or the suppression of terminal buds of over vigorous shoots, shortly before blossom, is often useful, especially to help in the forming of young vines. Topping, which is practised after blossom is very often injurious and seldom useful. It should be practised with caution, if at all. It is the summer pruning operation most open to abuse. Cincturing or girdling is only necessary in the case of the Zante currant, which drops most of its fruit, shortly after blossom, if not ringbarked in this way. The very vigorous Zante tolerates this rather brutal treatment, but other sorts are depressed by it to such an extent that its application is not to be recommended.

Downy Mildew.

I now come to my two special points, and am glad of this opportunity to stress them.

The first is downy mildew, a comparative newcomer that made its first appearance here in 1917.

Our seasons are mostly unsuitable for this fungus, and herein lies our danger. Immunity for several years lulls us into a false sense of security and the neglect of control measures. A wet season comes around with disastrous results to the unprotected vine. Spring outbreaks are particularly deadly; the entire crop may disappear in a few days.

Control is easy and comparatively cheap, but it must be taken in time—too late spells disaster. This fungus cannot be cured, but it can be easily prevented by copper-containing sprays. Bordeaux mixture, 10.5.50, preferably alkaline and with casein as spreader, is the standard spray. One must not wait for visible signs of the disease; it may then be too late to save the crop. Downy mildew spreads with extraordinary rapidity, if conditions suit it. The first development may escape notice, and yet be sufficient for widespread infection, should suitable weather supervene. Unsprayed vines are at the mercy of the weather, and on this it is notoriously unsafe to gamble. Warm rain would spell disaster. Southern French vignerons say that rain with the thermometer at 23 degrees (73½ deg. F.) is fatal. Such conditions are not improbable in a season like the present. Vines as yet unsprayed should be attended to without delay.

Copper-containing powders have been recommended recently; these are useful, in a wet spring, to supplement the spray, but they should on no account be looked upon as a substitute for it. To rely on dusting alone, in a bad mildew season, would be courting disaster.

Bordeaux is also efficaceous against black spot at this time of the year. It is the complement of the winter swab in the complete or two-fold control of this fungus.

Further details are impossible to-night, but bulletins will be posted on application to the Department of Agriculture.

Sulphuring.

This is the standard treatment of vine oidium, a fungus that differs radically from downy mildew. Growing, as it does, on the outside of the plant tissues, it is the only vine fungus amenable to curative treatment. Nevertheless, prevention, in the shape of early dusting, is to be preferred.

Wherever oidium has to be reckoned with—and we must not forget that it is responsible for more damage than it is usually credited with—vines must be sulphured. Details are given in a bulletin on oidium, obtainable on application to the Department of Agriculture.

What I desire to emphasize here is that even in the absence of oidium, it pays to sulphur vines. Applied at blossom, a better setting of fruit results. Later on in the season, it has a marked tonic action on vegetation.

Sulphured vines are of a darker green and more healthy colour, and they ripen their fruit earlier. Two or three sulphurings in December and January will advance maturity by a week or, perhaps, even more.

Sulphur is also of great use to control erinose, sometimes described as warty leaf, caused by a microscopic mite, a parasite that sometimes causes damage, more particularly to Gordos and Doradillos. Two or three sulphurings in summer will effectually check its spread.

Sulphur should not be applied during a heat wave; some scalding may result if the shade temperature exceeds 100 degrees. The work should not be commenced before 10 a.m., by which time the probable maximum can be guessed at. The early morning sulphuring of former times " with the dew on " is now known to be unnecessary.

Sulphur is cheap, and with the horse-drawn, traction sulphurers now obtainable, a large area can be treated in a day, at a small cost, which is well worth while in view of the real benefits that result.

Practical growers who have followed my advice in this matter have expressed to me their satisfaction with the result and their intention to make sulphuring a routine operation in future. The application at blossom should never be neglected. Later sulphuring should be given whenever an advance in the date of ripening is an advantage.

THE POULTRY INDUSTRY.

DISPOSING OF EGGS.

By W. C. Rugg, Chief Poultry Expert.

The Necessity for Export.

It is very gratifying to all interested in the poultry industry to see the great interest that is being taken in the export of eggs this season. For some months past, officers of the Poultry Branch of the Department of Agriculture have not missed an opportunity, at lectures, by correspondence, and by personal interviews, to bring under the notice of poultrymen the critical position of the egg-producers of Victoria. This position has been brought about by the tremendous increase in the number of birds kept for egg production in all parts of the State, which means that ever increasing quantities of eggs are being produced, and most of them are coming on to the Melbourne market. There seems to be no slackening off in the numbers of people starting operations as poultry-keepers and poultry-farmers. Hence the necessity for stressing on every possible occasion the need for the export of every suitable egg during the next 8 or 10 weeks.

It is not possible to know how many eggs are received in Melbourne each week, owing to the fact that a number of the largest farmers, that is those who keep from 5,000 to 20,000 laying hens, deliver by motor lorry all the eggs produced on their farms, direct to hotels, clubs, hospitals, grocers, and produce stores, to say nothing of the scores of smaller farms, from which eggs are delivered direct to customers. Some indication of the great increase that is taking place is shown by the figures published by the Railway Department of the number of tons of eggs forwarded to Melbourne by rail. During August of this year, 696 tons were received by rail, an increase of 118 tons over the same month a year ago. In September, 1927, 772 tons of eggs arrived at Spencer-street; last month, 1,185½ tons reached Melbourne, which is an increase of 413½ tons over the same month last year.

I must repeat what I have said many times recently—that it is the duty of every egg-producer, no matter how small, to export some eggs, and also to use whatever influence he has to induce others to do the same, for it is only by export that we can prevent an accumulation of large quantities of eggs in cold storage, which will assuredly be brought out in the winter against the producers of new-laid eggs, and maybe lower the price below the cost of production.

When we study the figures relating to export this season, the outlook is promising, compared with last year. Up to 29th September, 1927, only 3,311 cases, representing 1,191,900 eggs, had been sent to London. I am pleased to be able to state that a wonderful improvement has taken place this year. Up to 11th October, 12,425 cases, representing 4,473,000 eggs, had been shipped out of the country. This is over three and a quarter million eggs more than had been sent away by, say, the middle of October, 1927. What the price of eggs would be to-day had it not been for these heavy shipments, I do not like to reflect upon. I think we should all be proud of the men who have combined to make this possible; producers, exporters, inspectors, and shippers are all

entitled to our sincere thanks for averting what would have been almost ruin to many of the smaller poultrymen.

I trust that no one will relax any effort to make the number of eggs exported this season a record; and not only as regards numbers; let all strive to see that the quality, cleanliness, size, and freshness of the eggs sent in to the grading depots are improved. We all hope that exporters and inspectors will do their part, and see that only the very best are allowed to be packed, so that the British merchants and consumers can be assured that we are making an honest endeavour to supply them with eggs equal, if not superior, to those sent from any other country. This we can assuredly do, for we have the men who know their business as producers; we have a climate second to none in the world for the production of every class of food that is needed, and we have utility strains of poultry as good as, if not better, than those in any other country. All that is needed is a little better understanding between the various sections of poultrymen, and they can make their industry a sound and profitable one for all time.

What is a Reasonable Size? Is a 2 oz. Standard too High?

A few weeks since a paragraph appeared in the commercial column of one of the daily papers to the effect that "the chief benefit of export has previously been the stabilization of the home market, and that owing to the revised regulations only eggs of 2 oz. or more may be despatched from Australia. As a consequence, it is found that many eggs are being rejected, and are being forced on to the home market for sale, and that their sales have already had a depressing effect on the market!" (It is not permissible to export eggs which are less than one and seven-eighths of an ounce in weight. The minimum weight of a long hundred (10 dozen) is 15 lb.; thus the average weight of each egg must be 2 oz.

An officer of the Poultry Branch made inquiries at the time from several of the principal exporters, and they were unanimous in stating that they were experiencing no trouble in getting a very fine percentage of large eggs—in fact, they were exporting over 75 per cent. of the eggs submitted, and they also stated that the all-round quality and size of eggs this year show a very great improvement on last year's eggs.

Another paragraph stated "Provision was made last season for a $1\frac{3}{4}$-oz. pack, and large quantities of eggs were packed into this class, and sold well in England."

The facts are that, as far as Victoria is concerned, out of a total of 10,494 cases packed for export, there were only 105 cases of small eggs, and 47 of these went to countries other than the United Kingdom; thus only 58 cases of small eggs were shipped to London. Evidently the consignors did not have a very high opinion of the prices they were likely to bring, or they would have sent more.

It was also stated that "the standard of a 2-oz. egg is high." It might be in Egypt and India and a few other places, but not in England. I have in my possession an old English cookery book, printed over 70 years ago, and every reference to eggs describes them as 2-oz., or four eggs to the $\frac{1}{2}$ lb.—eight eggs to the 1 lb.

When Mr. Crowe, Exports Superintendent of the Department of Agriculture, visited England for the Wembley Exhibition, he wrote strongly advising poultrymen to concentrate on exporting a 16-lb. pack,

and we have it on the authority of two exporters who visited England recently that London merchants want eggs of 2 oz. or over, and contracts entered into demand the 2-oz. standard.

Nobody denies that, as far as internal quality is concerned, smaller eggs may be very good, but they cannot be exported from here and sold at a price which will show a profit, owing to the fact that large quantities are produced in the Continent, where labour is cheaper than it is here, and where shipping charges are lower.

Co-operation Essential.

Probably the Australian poultryman has never before had such a good chance as he has to-day of capturing a really good share of the millions of pounds England spends annually in purchasing eggs. Although the production of eggs in England is increasing, the increase is not at a rate sufficient to meet the growing demand, and consequently her imports are steadily rising in numbers.

Several countries from which very large quantities of eggs were exported to London in the past are now, for various reasons, sending much smaller shipments. London's imports from China, Denmark, and Poland, particularly, show a marked decline. So now is Australia's time to get a firm hold of a portion of that business, and at the same time relieve our market at the season of highest production. This can be done, and all that is necessary is co-operation between the various organizations for export.

There are a number of poultry organizations which are doing a great deal of good work, and there is room for them all. But some of them, I fear, spend too much time trying to depreciate the efforts of some of the others. Competition is a good thing, but I want to assure the members of these organizations that the position of their industry to-day is too critical to permit of trivial differences of opinion being allowed to injure the overseas or the local trade. Unless members are prepared to sink their differences on one subject at least, and that is the marketing of their products, they will bring hardship and financial loss on themselves.

Increasing Local Consumption.

It is the duty of every poultry-farmer to endeavour to find markets for the great number of eggs that are now being produced in Victoria. The hatching season is just over. The export season will finish in 8 or 10 weeks, and then there will be a tremendous number of eggs for which to find a sale. If the poultrymen will face this problem with determination as strong as that with which they tackled the question of export, there is no likelihood of a collapse of prices, such as is being predicted by some of the pessimists to-day. By co-operation, publicity, and advertising, the consumption of eggs can be increased enormously, and now is the time to start to bring the good qualities of eggs more prominently under the notice of consumers.

A campaign to increase the consumption of eggs is absolutely necessary if the poultry industry is to expand and become a profitable one.

Poultrymen are in a wonderful position to launch such a campaign, because they have an article to sell which is second only to milk as a nourishing concentrated food, which can be highly recommended for

both the weak and strong, the child and the adult, the invalid and the healthy. Though eggs are, of course, almost indispensable to most housewives, still there are scores of new and attractive ways in which eggs can be prepared for food, &c., that would bring about a very much increased demand; and it is a well-known fact that when a producer has a good article, the home market is always the best market.

As an example of what can be done in this direction, I would direct attention to what has been done in Canada. Seven years ago, the consumption of eggs per capita was given as 118 eggs per annum. According to the latest report, the average consumption of eggs per person last year (1927) was 350.

It is very doubtful if in Victoria the average yearly consumption of eggs is 120 per person. I suppose it is not likely that the standard of living in Canada is any higher than it is here; therefore, I would suggest that what has been done by Canadians in the way of increasing the home consumption of eggs can surely be done by Victorians. Seven years ago, the Canadians began a campaign with the slogan "An egg a day," and it certainly looks as if that objective will be attained at an early date.

I am sure that the poultry industry has a wonderful future. But poultrymen themselves must have faith in their industry, and be loyal to it by striving to produce and market a better article in a better way, and, while they are doing it, they must not forget to keep telling the public all about it.

PROSECUTION UNDER FUNGICIDES ACT 1916.

Insecticides below Prescribed Standard.

In the Essendon Court of Petty Sessions, George Albert Hastings, trading as the Ascot Manufacturing Company, of Mt. Alexander-road, Moonee Ponds, was, on the 22nd of October, charged with having sold "Ascot" brand of nicotine, lime sulphur and arsenate of lead which did not comply with the respective standards prescribed under regulations.

Mr. W. C. Robertson, supervizing analyst, inspected defendant's factory and purchased the samples in question. His analyses showed that whereas the prescribed minimum content of nicotine was 20 per cent., the sample of "Ascot" nicotine contained only 0.58 per cent. nicotine, although it was labelled to contain 40 per cent. The sample of "Ascot" lime sulphur was found to contain 9.75 per cent. soluble sulphur, whereas the prescribed minimum was 20 per cent. In the case of the sample of "Ascot" arsenate of lead, the prescribed minimum content of arsenic pentoxide was 25 per cent., and the sample contained only 13.1 per cent.

Mr. G. Wilson, of the Crown Law Department, appeared for the prosecution. The defendant pleaded ignorance of the prescribed standards. A conviction was obtained on each charge, and the defendant was fined £10 with £2 8s. 9d. costs in respect of nicotine, and £5 with £2 2s. costs in each of the two charges respecting lime sulphur and arsenate of lead.

FEEDING COD LIVER OIL TO COWS.

Effects on the Richness of Milk.

[Paper read by John Golding, D.S.O., F.I.C., National Institute for Research in Dairying, University of Reading, at the World's Dairy Congress, 1928.]

The subject of Animal Nutrition on which I have been asked to address this Congress is a very wide one. That I should consider some aspect of the effect of nutrition on milk production was obviously necessary, but the problem involves milk as a link between succeeding generations, including not only the percentage composition as disclosed by its proximate analysis, but also a discussion of the relative value of milk yielded under varying conditions for the nutrition of the suckling animal of the same species. By limiting my subject to the nutrition of the cow and calf, I am able to avoid the problems of "the nutritional value of milk and the importance of milk in the human dietary" which subject is to be discussed later.

I have greater difficulty in steering clear of the subject selected for this afternoon's meeting of Special Section A, which I see includes nutrition among the various factors which must be considered when estimating the true value of the milk record of a cow. My avoidance of this aspect of the subject is all the more difficult as I am convinced that the solution of many of the practical and bio-chemical problems of milk production will only be found in the domain of animal physiology, and for this reason, I wish to stress specially the need for more physiological work in dairy research in the immediate future.

The problem which I propose to bring to your notice is a case in point, the solution of which may, with the help of the physiologist, throw some fresh light on the subject of fat secretion. There are many points about the secretion of fat in milk which are obscure, but it seems certain that within the limits of adequate nutrition, diet has, as a rule, no direct influence on the percentage composition of the milk. Even when the volume of the milk yield is increased by diet, the percentage composition seems to be unaltered beyond the limits of variation due to other causes.

In the course of a series of experiments on the winter feeding of cows, however, it came as a surprise to us to find that when cod liver oil was included in the diet of a cow in excess of a certain amount, the percentage of fat in the milk fell to a degree far below the limits of the daily variations without influencing the daily volume of the milk.

This series of experiments was designed to investigate the vitamin value of cows' milk, and the cod liver oil was added as a concentrated source of the fat soluble vitamins. The addition of the cod liver oil to the food of cows also altered the physiological value of the fat in the milk yielded, to such an extent, as to effect a tenfold increase in such a measurable factor as its growth-promoting properties. It also improved the antirachitic properties of the resulting milk fat.

I wish to limit my remarks to these three effects on the richness of cows' milk produced by feeding cod liver oil, viz., the increase of vitamin A in the milk; the increase of vitamin D in the milk, and the decrease produced in the percentage of fat in the milk.

There are many other effects, some of which have been investigated at the National Institute for Research in Dairying and others at the

Rowett Institute, but our results in a case in which a definite constituent of the diet may have an influence on the percentage composition of the milk of a cow and on the physiological value of her milk even when the diet is adequate for milk production.

It may be urged that cod liver oil which effects these changes is not a normal constituent of the diet of a cow, but the physiological benefits which result from its use and the fact that in smaller quantities the adverse changes do not take place, make its use worthy of exploration. From the practical side the cost of the oil required is not great, and the addition of a natural active product which can restore winter milk to its summer vitamin value is of dietetic importance.

The series of experiments to which I have referred were originally designed to investigate the effect of winter rations on the fat soluble vitamins of the milk of winter-fed cows but were subsequently extended over seven years and involved prolonged feeding trials on groups of Dairy Shorthorns, over sixty cows in all. The milk of the cows was tested for fat at each milking. The cows were milked by hand, and as a rule, at intervals of nine and fifteen hours.

The various rations supplied were, in all cases, adequate for milk production, and may for convenience be classified under three headings: Firstly, those which were specially selected to give a basal ration low in fat soluble vitamins. These consisted of selected concentrates, seeds, hay or oat straw and mangolds. Secondly, those in which a normal winter ration was fed consisting of concentrates, meadow hay and mangolds, and in some cases vetch and oat silage. Thirdly, those in which grass feeding or partial grass feeding took the place of winter rations when the experiments were extended into the summer.

In some of the experiments olive oil or arachis oil was given to the control cows in quantities equal to the cod liver oil supplied. In other experiments rice oil was compared with cod liver oil. In each experiment the cod liver oil was given in increasing amounts, some cows being limited to two ounces (=56.8 c.c.) per day, other cows having the dose increased to 6 or 8 ounces. In all cases the oil feeding was continuous for three or four months, sometimes starting in December, but always being given in January, February, and March. In the first instance, cod liver oil was selected as being a convenient, potent and inexpensive source of fat soluble vitamins, but in all cases the percentage of fat and the weight of milk of the cows under experiment was always determined at each milking not only while the cod liver oil was being fed but also for a period both before the feeding of the cod liver oil started and for a period after the last dose had been given and, in some cases, throughout the whole lactation.

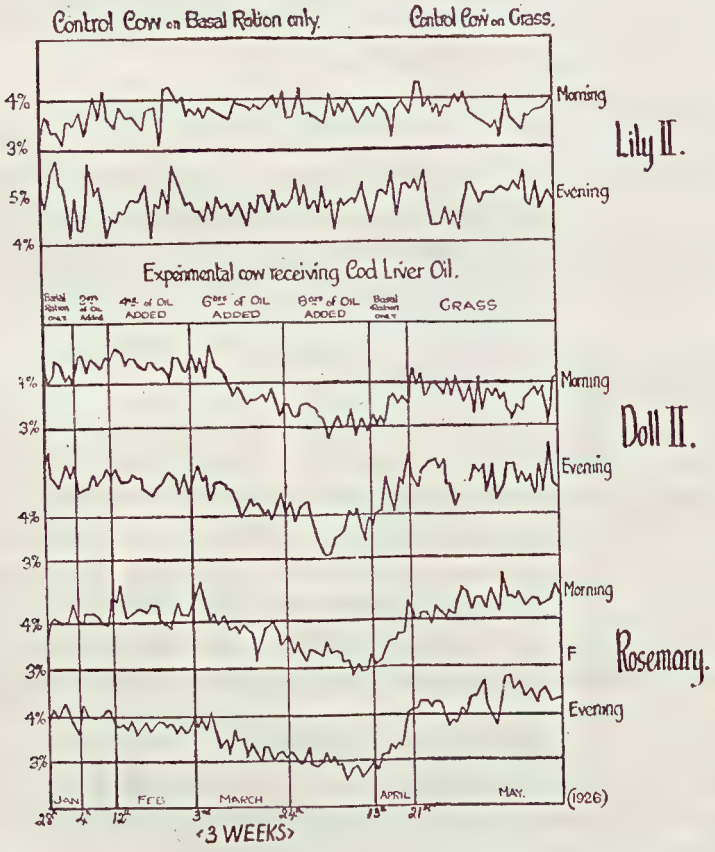
The cod liver oil when given in quantities of 2 to 4 ounces, had as a rule but little influence on the fat yield, but when the quantity was increased, it came as a surprise in the earlier experiments, to find that the weight of fat in the milk was depressed and that to no uncertain extent. Making all allowance for the normal depression of fat due to the advance of lactation, the depression attributed to the oil amounted to from 15 to 25 per cent. In some cases, as seen from the charts, falls in the percentage of fat equal to over 40 per cent. followed after increasing the oil, the low level being maintained till the oil was discontinued, when as a rule a rise in the percentage of fat took place.

As examples of the magnitude of the drop in the percentage of fat, charts 1 and 2 show the results obtained in the 1925 and 1926 experiments.

In each case the percentage variation in the fat of the milk of a control cow is shown at the top of the chart.

It will be observed on comparing the two charts that whereas in 1925 a drop in the percentage of fat occurred when 4 ounces of cod liver oil was given to the cows, in 1926 4 ounces did not depress the fat in the milk, but a fall took place when 6 ounces or more were added.

CHART SHOWING THE DEPRESSION IN PERCENTAGE OF BUTTERFAT DUE TO EXCESS OF COD LIVER OIL IN THE RATION.



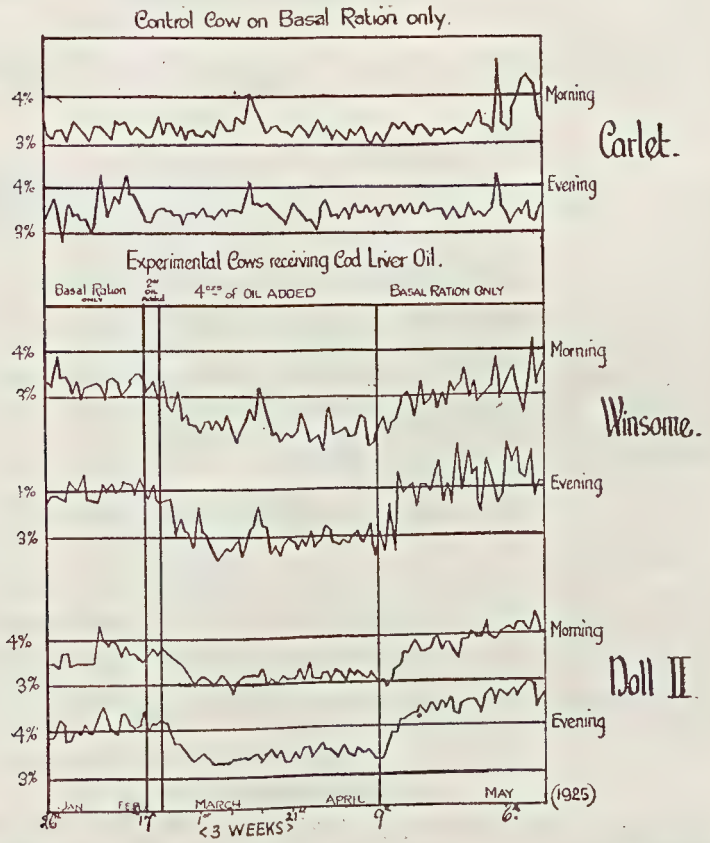
At the time of writing, fourteen cows are under experimental feeding with cod liver oil, and it is hoped that the results obtained may throw more light on the cause of this depression.

Other experiments have been conducted with a view to finding out which factor in the cod liver oil is the cause of this depression. As an example, the unsaponifiable fraction from cod liver oil, after being dissolved in arachis oil, has been fed to two cows in increasing proportions,

estimated to be equivalent to upwards of 8 ounces of cod liver oil in fat soluble vitamins. A commercial preparation of the vitamin fraction of cod liver oil has also been fed in the same way to two other cows. In neither case was any depression observed.

In the course of the above-mentioned series of experiments olive oil or arachis oil has been given to control cows in quantities equal to the cod liver oil given to the experimental animals, but in no case was any depression of fat in the milk observed.

CHART SHOWING THE DEPRESSION IN PERCENTAGE OF BUTTERFAT DUE TO EXCESS OF COD LIVER OIL IN THE RATION.



Passing to the qualitative side of my problem, I wish to call your attention to two substances only which are associated with the butterfat and which possess physiological properties in a high degree. I refer to the vitamin A associated with growth and the vitamin D known as the antirachitic vitamin.

In making this selection, I am influenced by the fact that I have been engaged in the investigation of the vitamins of milk fat for the past eight years.

In the work on the subject of the variations of the vitamin content of cows' milk under different conditions of feeding, I have had the good fortune to be associated with Dr. S. S. Zilva and other workers at the Lister Institute, and with Dr. J. C. Drummond and other workers at the London University.

Our earlier work on which I contributed a paper at the meeting of the World's Dairy Congress in the United States, and on which we have published several papers, dealt with vitamin A only. Since the separate identity of vitamin D has been established, the work has been repeated and the vitamins A and D separately assessed by my collaborators, Miss K. M. Soames and Dr. S. S. Zilva by a technique, the details of which are published in a joint paper in the *Biochemical Journal*, Vol. XX., No. 6, 1926. Growth of rats was taken as a criterion for the assessment of vitamin A. The diet used was free from fat soluble vitamins, but the first decline in weight shown by the rats in the preliminary period of feeding had been temporarily arrested by a supply of irradiated hardened cotton seed oil. This procedure met the objection raised by Steenbock, namely, that growth in rats cannot be accepted as a reliable criterion for the assay of vitamin A unless other vitamins are available in adequate amounts.

In the above-mentioned paper, the technique for the estimation of vitamin D is also described. In the assay both of vitamin A and vitamin D in the butters made from the cream from the milk of the experimental cows, daily doses of 0.2 and 0.6 grammes of butter were used per rat. The analysis of leg bones (femur, tibia, and fibula) of the rats was made after feeding them for 28 days on the butter obtained from individual cows under experiment, the results being compared with rats fed on the basal diet (negative controls) and with rats receiving cod liver oil (positive controls). The results were expressed in terms of the ratio of the ash in the bone to the organic material other than substances extracted with hot alcohol and ether. This so-called A/R ratio is a reliable index of the degree of calcification of the bones and convenient for purposes of comparison.

The results of these later experiments confirmed the earliest findings as to the great improvement in growth-promoting properties conferred on the milk by feeding cod liver oil. Green kale fed instead of the mangold ration in winter time produced a similar effect in raising the vitamin A in the milk. Cod liver oil, on the other hand, when fed in doses of over 2 ounces per cow per day, did increase the antirachitic properities of the butter even over that produced on a ration containing silage and hay as is shown in the 1926-27 results published in the *Biochemical Journal*, March, 1928.

Conclusions.

The conclusions reached as a result of the foregoing experiments are that the elusive and variable quality of richness associated with milk fat can be experimentally controlled at will in three directions by feeding cod liver oil to cows—

1. Its physiological property of growth promotion associated with vitamin A can be increased tenfold as compared with a basal ration of straw, mangolds and selected concentrates.
2. Its antirachitic properties associated with vitamin D can also be increased to a marked degree as compared with a similar control ration.

3. The percentage content of fat in the milk can be reduced by feeding more than 4 to 6 ounces of cod liver oil per cow per day.

The cause for this phenomenon and for the more natural variations in the fat content of cows' milk requires still further investigation from a physiological stand-point.

WHEAT GROWING IN THE MALLEE.

FIELD DAY AT CARWARP.

The experimental plots conducted by the Department of Agriculture on the farm of Mr. P. G. Stewart, M.H.R., at Carwarp, were inspected by some 350 Mallee settlers on Saturday, 13th October, when the annual field day was held. The visitors were conducted over the plots by the Superintendent of Agriculture, Mr. H. A. Mullett, B.Ag.Sc., who explained the work being done, and outlined the results so far obtained.

Referring to the adverse season that had been experienced in the northern Mallee this year, Mr. Mullett pointed out that the history of wheat growing in Victoria was one of ups and downs, but over a long period of years there had been a steady advancement. In the Mallee alone, for example, the average yield per acre had been increased by over 200 per cent. in the past 25 years.

That advance was founded on certain fundamental principles, and the success achieved proved those principles in the main to be right. One of the principles pre-eminent as the foundation for a successful crop was early and well-worked fallow. By that he did not imply that fallow should be worked when there were no weeds or when the surface was not set. No system of farming, however, could be made sufficiently accommodating to produce good yields. When the rainfall had not been more than 2 inches from the time of sowing to the end of September, successful crops, or at least crops that looked best at the moment, were mainly matters of chance in such conditions. In most instances well-farmed crops looked best, but in others some indifferently-farmed crops looked better than the well-farmed crops alongside. It was not difficult to illustrate this apparent anomaly. A crop to yield, say, 15 bushels per acre required a reasonable number of plants per square foot, and these plants placed a certain drain upon the soil moisture which could not be met with only 2 inches rainfall in the period mentioned. On the other hand, a thin crop, on indifferently farmed land, and which could not be expected in a normal season to yield more than 5 or 7

bushels per acre, would have fewer plants per square foot, and would place less drain upon the soil moisture. Therefore, in a season like this, those plants stood up well.

In other instances hot winds and pests had affected certain crops but not others. Until the plant reached maturity it was susceptible to such influences. For example, a crop with the head peeping out of the flag was very tender, and in a hot wind it might be tipped off, while, on the other hand, a crop further advanced when the hot winds came would not suffer so much. It was obviously just a matter of the stage reached by the crop at the time of the hot winds. He would urge all to stand firmly to their guns in regard to better-farming methods.

So far as the fallows were concerned, the Department had advocated that the fallows should be early and worked as far as possible while moist, and as often as necessary to kill the weeds or to break the surface crust. Some enthusiasts had gone far ahead of that policy with a view to getting perfection by working their fallows, whether loose or not, and in season as well as out of season, in the hope that they might do good thereby.

On loose soils not only was no benefit likely to accrue from such a practice, but definite harm might result if the field were worked dry. An illustration of that was to be seen at the Carwarp experimental plots. He desired to warn settlers in the northern Mallee not to attempt to unduly work their fallow, or, on the other hand, to infer that a judicious amount of working at the right time was not an improvement, and hence possibly lead them to neglect their fallow.

Continuing, Mr. Mullett pointed out that from 1st January to the end of September the total rainfall recorded at Carwarp was 824 points. Of this total, 495 points fell in January, February, and March, while, since the plots were sown in May, the rainfall (to the end of September) was 312 points.

The season opened favorably, but the splendid summer rains were followed by a comparatively dry autumn and winter. The crops started off well, but the dry conditions and severe winds dispelled the early hopes of high yields, and, when the rain came at the end of September, the crops were too far gone to fully recover.

Despite the dry season and the fact that yields on the plots were likely to be light, it was decided to proceed with the annual field day, as the experience last year had shown that the comparisons afforded by the experiments were even more instructive in a dry season than in a normal year.

Results from Experimental Plots.

In submitting the results from the plots for 1927 and previous years, Mr. Mullett emphasized the fact that the policy of the Department was not to recommend the sowing of varieties of wheat or oats which had not been sown in the plots and given satisfactory yields for at least three years. This precaution was necessary, because, owing to the fluctuations

in the yields of varieties occurring in some seasons, it had been noticed frequently that varieties which did well in a good season had failed when the supplies of soil moisture were less abundant.

Yields 1926, and Averages Since Tests Started.

Cultivation Tests.

Fourteen Plots each ½ acre, sown to Rajah wheat, 4th and 5th July, 55 lb. seed and 80 lb. super. per acre. The pickle used was copper carbonate, 2 oz. per bushel.

	Yield 1927. Bushels per acre.	Average 3 years, 1925–26–27. Bushels per acre.
Summer Fallow.		
*Ploughed February, ploughed winter† ..	6.1	12.4
Ploughed March, ploughed winter† ..	4.7	12.3
Ploughed March, spring-toothed winter†	4.4	12.1
Spring-toothed March, spring-toothed winter†	4.7	12.7
Winter Fallow.		
Ploughed July, 2 inches deep†	4.1	11.7
Ploughed July, 3½ inches deep† ..	4.5	12.6
Ploughed July, 6 inches deep†	4.0	12.3
Ploughed July—spring-toothed (deep) ..	3.0	11.5
Ploughed July—spring-toothed (dry) ..	2.3	10.7
Ploughed July—spring-toothed† ..	3.2	11.8
Ploughed late (October)†	0.6	9.6
Ploughed July (neglected)†	0.7	8.5
Ploughed May, 1926 (non-fallow)† ..	0.1	6.0
Ploughed October (neglected)†	0.4	8.5

* Corresponding fields ploughed March, 1925, and spring-toothed in July.
† Except where otherwise stated, depth of ploughing 3½ inches, and fallows spring-toothed and harrowed as required after rain to maintain mulch 2½ inches deep.

The outstanding feature of these trials in 1927 was the superiority of the earlier and better worked plots over those on which the workings were less than standard. This is in conformity with results obtained throughout the wheat belt.

Though last year's results are most striking and indicate clearly the relative values of the various cultivation practices in a dry year, the average yields obtained since the plots were commenced three years ago must be regarded as the more reliable guide.

It will be observed that the average yields on the plots fallowed are practically double those on the non-fallowed land, while those on late fallow and on neglected fallow are definitely below the yields on carefully fallowed plots. This is a lesson which settlers in the Northern Mallee are taking to heart, and it is recognized now that the substituting of fallow for non-fallow, and well-worked fallow for neglected fallow, would go a long way towards ensuring a steady sequence of satisfactory crops.

The average results disclosed no significant differences between summer fallow and winter fallow, or between the various depths of ploughing tested, but it is to be expected that some will be apparent as time goes on. Some modification of the layout of the tests was made last year to ensure greater accuracy.

Results of Manurial Trials.

Federation wheat sown 2nd and 3rd July. 55 lb. graded seed, pickled with copper carbonate.

Quantity of manure per acre.	Yield per acre. Bushels.
No manure	1.9
Super. 30 lb. per acre	3.5
Super. 60 lb. per acre	4.2
Super. 90 lb. per acre	5.5
Super. 120 lb. per acre	4.8

The average yields since the plots were started provide a very reliable indication of the value of superphosphate under average conditions in the Northern Mallee. While, on the majority of occasions, the plots were sown on fallowed land, on three occasions, in 1916, 1921, and 1922, they were sown on new land not fallowed. The most profitable dressing of manure applied in those years was 60 lb. an acre.

Average Yield for 12 Years (1916-1927).

Showing Increase due to the Use of Super.

Quantity.	Average Yield per acre, 1916-1927.	Increase over no manure.	Value of Increase at 5s. bushel.	Cost of Manure at £5 12s.	Net Profit per acre due to Manure.
	Bushels.	Bushels.	s. d.	s. d.	s. d.
No Manure	10·5	..	..	..	..
Super. 30 lb per acre ..	13·1	2·6	13 0	1 6	11 6
Super. 60 lb. per acre ..	13·9	3·4	17 0	3 0	14 0
Super. 90 lb. per acre ..	14·6	4·1	20 6	4 6	16 0

These results are in accord with the results of manurial trials carried out in different Mallee districts for a number of years in that they show that, on well-prepared fallow land, 90 lb. of super. per acre is the most profitable fertilizer dressing.

The great assistance superphosphate can give to the wheat plant in helping it to combat weeds was illustrated well on these plots last year, when the unmanured area was thickly studded with Bladder Wort while the adjoining manured areas were practically free from that weed.

Variety Trials.

Yield of Wheat Varieties, 1927.

Graded wheat sown, 55 lb. per acre on 29th and 30th June, pickled with copper carbonate. Super. 80 lb. per acre.

	Bushels per acre.		Bushels per acre.
Mogul	8.0	Ranee	6.9
Free Gallipoli	7.9	Federation	6.7
Ranee x Rajah	7.9	Federation	6.7
Rajah Selection 228	7.6	Currawa x Major x Gallipoli	6.4
Sepoy	7.5	Currawa	5.6
Ghurka	7.5	Merredin	5.6
Federation	7.5	Federation	5.5
Nizam	7.4	Yandilla King	5.2
Ind. F. x Federation	7.4	Nabawa	5.0
Mac's White	7.3	Bena	4.9
Federation	7.3	Wandilla	4.0
Rajah	7.1		
Confederation	7.1		

Average Yields for 5 Years, 1923-27.

	Bushels.		Bushels.
Sepoy	18.6	Mogul	17.1
Ghurka	18.5	Mac's White	17.0
Confederation	17.9	Rajah	16.9
Yandilla King	17.7	Nizam	16.7
Free Gallipoli	17.6	Currawa	16.5
Ranee	17.3	Federation	15.1

Rate of Seeding Tests.

Rajah wheat sown 1st July. Varying rates of graded seed. Pickled with copper carbonate. Manure, 80 lb. of 22 per cent. super.

Rate of Seeding.	Yield, 1927. Bushels per acre.
45 lb.	4.9
60 lb.	4.8
75 lb.	5.5
90 lb.	5.4

Average, 1925-26-27.

45 lb.	13.9
60 lb.	14.2
75 lb.	14.4
90 lb.	13.8

Replicated Variety Tests.

The replicated variety tests indicated that, under seasonal conditions similar to those experienced at Carwarp last year, Free Gallipoli was definitely superior to Yandilla King. Four Yandilla King plots gave an average yield of 5.8 bushels per acre, while the Free Gallipoli plots averaged 7.5 bushels per acre. The difference in yield of about 100 lb. per acre between the two varieties is regarded as a significant one. Sepoy also showed a definite superiority over Yandilla King, although in this case the difference was not so great as with Free Gallipoli. In these plots the Yandilla King averaged 5.7 bushels per acre and the Sepoy 6.7 bushels per acre. Ghurka also gave better yields than Yandilla King, the average difference between these two varieties being 50 lb. per acre.

These results confirm those obtained from the ordinary variety trials in this season, but the tests must be repeated over a period of at least three years before any differences that may be due to seasonal variations can be eliminated.

Variety Tests—Oats.

Sown with 60 lb. seed on 1st July, 1927. 80 lb. super. per acre.

Variety.	Yield, 1927. Bushels per acre.
Mulga	4.5
Palestine	4.4
Sunrise	4.2
Burt's Early	2.9
Belar	1.7
Lachlan	1.4
Algerian	1.0

Average Yields, 1925-26-27.

Palestine	16.5
Lachlan	16.1
Burt's Early	13.8
Algerian	12.3

METALS AND THEIR VARIOUS INFLUENCE ON MILK.

[Paper by O. F. Hunziker, Blue Valley Creamery Coy., Chicago, U.S.A., read at the World Dairy Congress held in Great Britain 26th June—12th July, 1928.]

Introduction.—The status of metals in dairy equipment, their properties, their resistance to corrosion in milk work and their effect on the flavour and quality of milk and milk products was brought before the World's Dairy Congress in Washington, D.C., in 1923, in papers presented by Seligman[1] and by the author.[2] Those papers called attention to some of the fundamental relations that may be expected to take place under milk plant conditions, and they quoted such plant experiences and experimental results as were then available.

The span of the past five years has seen the introduction of new metals and metallic alloys in the construction of dairy equipment. And considerable additional information has become available on the entire subject dealing with metals then and now used in milk plant equipment. It is hoped, therefore, that a brief discussion of this newer information may be of added value and service to the dairy industry, especially in view of the fact, now more fully recognized, that corrosion plays a very prominent role in the life of the equipment and in the determination of the flavour, keeping quality, and wholesomeness of the dairy product.

Summary of Earlier Work.

In the 1923 reports the following general facts regarding metallic action in milk and cream were pointed out:—

1. In order for any metal to suffer corrosion and to have an injurious effect on the milk or milk product, it must be capable of going into solution.

2. Solution of the metal may be the result of direct chemical action in the presence of the acids, mineral salts, and other constituents of the milk, or of contact with corrosive washing powders, chemical sterilizers, or brine. Or it may be caused by electrolysis, such as may result from the presence of two or more metals with different electrical potentials in contact with one another and immersed in the electrolyte—the milk, or other fluid product, or from stray electric currents reaching the equipment due to imperfectly insulated and insufficiently grounded motors in case of direct motor-drive machines, or leaky conduits within or in close proximity to the factory.

3. That the presence of air intensifies metallic corrosion as is particularly shown by the corrosion at the air-liquid line.

4. That injury to the flavour and keeping quality of the milk product as the result of corrosion may be due to the presence in the milk product of metallic salts or oxides which themselves have a metallic, bitter, puckery flavour, or to oxidative or catalytic action of these metallic salts and oxides on the milk constituents, or to bacteria-selective influences of certain metallic salts and oxides.

For References see page 692.

5. It was further pointed out that the salts and oxides of certain metals have distinct toxic properties, thus rendering the use of such metals unsafe from the standpoint of the wholesomeness of the dairy product.

At that time it was shown that copper and the copper alloys, monel metal and nickel silver, which were then much in use, failed to protect the milk product against metallic action, and against injury to flavour and keeping quality. Tinned copper was found suitable as long as the tin coating remained intact, but the short life of the latter greatly diminished the usefulness of tinned copper. Glass-enamelled equipment had then been recently introduced in the dairy field and its advent gave great promise for elimination of glass-enamelled difficulties. From the stand-point of the inertness of glass-enamelled surfaces in contact with milk and cream, glass enamel proved satisfactory at least as long as the enamel remained intact. However, the great corrosiveness of the steel side of the enamelled equipment, practically eliminated jacketed glass-lined tanks and confined the use of glass enamel to glass-enamelled shells and linings in metal coil vats. Since it is impractical to fabricate a satisfactory enamelled coil for heating and cooling, the problem of metallic flavour is not completely eliminated even here. Nickel was then also just being considered for use in dairy equipment. Its introduction and use was retarded on account of mechanical difficulties in fabrication. Aluminium had not as yet reached the point of wide application in the dairy industry in this country, but had been put to considerable use abroad with apparently fair success.

The item of high cost of materials and fabrication of some of the metal products of promising suitability, such as nickel, glass enamel, &c., may serve to explain, in part at least, their failure to enjoy their more rapid acceptance and wider use by the industry, and the continued popularity of such cheaper but less suitable metals as iron, copper, and copper alloys.

The Present Investigation.

It is not the purpose of this paper to further enlarge upon the various theories dealing with metallic corrosion in milk work. The present discussion will be confined mainly to a summary of specific results of an extensive investigation, in which was studied the effect of sweet and sour milk and cream, of organic and mineral acids, and of such other media as dairy equipment may be exposed to as, for instance, washing powders, chemical sterilizers, refrigerating brines, &c., on diverse metals, coated metals and metallic alloys now available and mechanically suitable for use in dairy equipment as well as the effect of these metals on the products themselves.

The procedure of the experiment consisted of immersing metal strips, either totally or partly, in the liquids under investigation. Every effort was made to simulate, as nearly as possible, the treatment and use which the equipment receives in commercial milk plant operation, such as providing wide ranges of temperature and periods of exposure, diverse successions of treatment, &c. All metal strips were thoroughly

cleaned, vacuum dried, and carefully weighed before and after immersion. The colour, character, and flavour of each liquid for each strip and the visible extent and character of corrosion of each strip were noted at the conclusion of each test.

General Observations.

On account of space limitations prescribed for this paper, it will be impossible to list in detail all the results obtained. However, in order to point out the relative merits of the various materials used for dairy equipment, a very brief general summary of the results in the various types of liquids used appears very valuable. A more complete report, containing full details of results, together with references to the work of others, may be found in an early issue of *The Journal of Dairy Science.*

Generally speaking, the results with milk and cream, sweet and sour, hot and cold, show that there is a close agreement between the flavour of the milk product and the extent of visible corrosion and loss of weight of the metal strips. Heavy loss in weight and profuse visible corrosion of the metal strips were almost invariably accompanied by the appearance of a distinct metallic flavour in the milk and cream. Slight changes in weight, however, did not always result in a corroded appearance of such strips, nor in any noticeable effect on flavour. On the other hand, there were cases of pronounced off-flavour in the liquid but without loss, or even with a gain in weight, of the respective metal strips. In the latter case, the bad flavour of the milk or cream was invariably accompanied by the appearance of very profuse corrosion of the metal. The fact that these corroded metal strips did not always show correspondingly great loss in weight must be attributed to the accumulation of oxidation products which offset, either partly or wholly, or more than wholly, the inevitable loss in weight of the metal proper. Because of this situation it was deemed essential to base the interpretation of the results not altogether on the weight figures, but also on the effect on the flavour of the milk product and on the extent and character of the visible corrosion on the metal strips.

Effect of Temperature.—In general, the higher the temperature the more intense in the chemical reaction. This was true also in the present experiment, and particularly so in the case of acids and alkalies. In the milk product, however, the effect of the temperature on the relation of metals to enzymic action may modify the results obtained. Thus, in the milk held at room temperature, a metallic flavour was noticed in the case of iron, copper, and galvanized iron. In the milk held at 145 deg. F., in addition to these three metals, the nickel silver and tinned iron also yielded metallic flavour. In the milk held at 180 deg. F., the only metals that affected the flavour were copper and iron, and in each case the off-flavour was only slight. In the sweet cream, both at room temperature and at 145 deg. F., again the copper and iron produced a very metallic flavour, nickel and nickel-silver also caused a slight off-flavour. In addition to this, in the cream held at 145 deg. F., the nickel-silver gave a very metallic flavour, and the monel, aluminium manganese alloy, and galvanized iron, a slightly metallic flavour. These results suggest that the higher temperature (145 deg. F.) intensifies

the production of metallic and other off-flavour, but when the temperature is raised to a point (above 176 deg. F.) at which oxidative enzymes become inactivated, the tendency of damage to flavour is greatly reduced. It is of interest here to note that Rice and Miscall[3] found that copper was more soluble at 145 deg. F. than at either room temperature or at the boiling point of milk.

It was also noted that the character of the flavour varies considerably with the metal. Thus, copper and copper alloys tend to produce a metallic, tallowy flavour character, while zinc and iron products caused in some cases a fishy and in other a foul, putrid flavour in addition to the metallic character. Similar observations are recorded by Quam,[4] who reports that low-carbon steel has a greater effect on putrefaction than copper.

Effect of Acidity.—Generally, the higher the acidity and the stronger the acid the more intense the metallic action. This was the case both with the acid solutions and with the milk products. These results gave evidence that those metals which were attacked by lactic acid were affected almost equally as seriously by the other organic acids tried, even by a .2 per cent. citric acid solution.

These tests gave marked proof of the great resistance of Superascoloy* to corrosion. In the weaker organic acids, such as lactic, acetic, butyric, and citric, the ordinary chromium steels, ascoloy† and enduro,‡ resisted corrosion nearly as completely as superascoloy. But it was the inorganic acid solutions that embraced the most decisive test of resistance to corrosion. In sulphuric and hydrochloric acid solutions the ordinary chromium steels failed to stand up. They rusted and pitted profusely and lost over 100 mgm. per square inch in sulphuric acid, and nearly 200 mgm. in hydrochloric acid, suggesting that when corrosion in these stainless steel products once starts they go to pieces rapidly.

But not so with superascoloy, which contains, in addition to chromium and steel, some nickel. Superascoloy resisted sulphuric acid completely, showing not the slightest discoloration and no change in weight. In hydrochloric acid this alloy did show some attack and some loss in weight, but even here the change was not great, and far less than in the case of any of the other metals and alloys under experiment.

Of the other metals, aluminium and aluminium alloy resisted corrosion in the organic acid solutions best, that is, next to the stainless steels. In sulphuric acid they also stood up better than any metals outside of superascoloy, although they suffered considerable corrosion and loss in weight. In hydrochloric acid, however, aluminium and its alloy failed to show resistance, and they lost about 100 mgm. per square inch in weight. The aluminium plated alloy, however, showed only slightly more loss in weight than superascoloy.

* Ascoloy, a chromium steel, containing approximately 12–16% Cr., 5% Si., 5% Mn., 0·25% P., 0·25% S.

† Enduro, a chromium steel, containing approximately 16·5–18·5% Cr., 5% Si., ·3–·75% Mn., and less than ·1% C.

‡ Superascoloy, a chromium nickel steel, containing appromimately 17–20% Cr., 7–10% Ni., and less than ·5% Mn., ·5% Si., ·025% P., and ·025% S.

Next in the line of resistance to acids follow nickel and tin, monel metal and nickel silver, tinned copper, tinned iron and copper. Of these, monel metal and nickel silver showed the greatest resistance to the organic acids, while nickel, monel and tin stood up best in the mineral acids.

The remaining metals, namely, iron, zinc, and galvanized iron, showed the least resistance of any of the metals in acid solutions.

In general, it was noted that where the metal was able to resist corrosion in acid media it also did not produce undesirable flavours, and was not seriously attacked by milk and cream, the highly complex colloid nature of the dairy product apparently not altering the general resistance of the metal to corrosion by acids.

Effect of Alkalies.—The importance of resistance to corrosion of metallic dairy equipment in alkaline washing powders and alkalies in other form is self-evident. The cleaning of such equipment makes indispensable the use of alkalies, and yet the action of these alkalies on the metals must inevitably influence the resistance and effect of the metals on the milk product. The alkaline washing powders most commonly used in milk work are caustic soda or special alkalies, sodium carbonate, such as sal soda and soda ash, neutral sodas, such as Wyandotte cleaner and cleanser, and tri-sodium phosphate, either as such or in the form of such commercial preparations as oakite. Alkalies may also be encountered in brines and chemical disinfectants.

As far as the resistance of the individual metals to washing powders is concerned, this series of tests demonstrated that the chromium steels are practically inert, and are closely followed by nickel, monel, and nickel silver. Tin suffers considerably, especially in the case of the stronger alkalies, but its resistance is decidedly improved by the presence of a small amount of sodium chromate in the cleaner. Copper, iron, and zinc are attacked considerably, while aluminium and aluminium alloy are practically destroyed. However, with the addition of sodium silicate to the soda (sodium carbonate) this washing powder does not attack the aluminium and aluminium alloy.

Effect of Calcium and Sodium Brines.—The resistance of metals used in dairy equipment to brine is important in so far as such equipment is used for brine cooling. Both calcium and sodium brines are corrosive to several of the metals used. Efforts to diminish the corrosive action of brines have led to diverse treatments of brine, such as the addition of an alkali or of sodium chromate and di-chromate, or of sodium silicate.

These results clearly demonstrate that, as far as those parts of dairy equipment as are exposed to brine are concerned, nickel, nickel alloys, such as monel and nickel silver, and chromium steels are by far the most suitable. Of these, superascoloy and nickel proved to be the best. There is also unmistakable evidence of the utter unfitness of iron and steel for jackets and other cooling surfaces where brine is used. This explains the experience in plant operation with jacketed steel tanks, which shows the steel jackets to corrode very rapidly and to rust through in a comparatively short time, often after 18 to 24 months' use. Because of the great corrosiveness of zinc in brine, galvanized iron is

practically as unsuitable for such purposes as iron and steel. Aluminium and aluminium products give promise as highly satisfactory metals in sodium brine treated with chromate or silicate, while tin and tinned copper receive their greatest protection from the chromate-treated brine. The corrosiveness of brine on all metals affected is very noticeably reduced by chromate treatment. Other treatments tried have, in general, not proved as effective as was expected.

Effect of Successive Steam Heating and Brine Cooling.—The usual factory operation involves the heating with steam or hot water, and cooling with water and brine successively in the same equipment. Generally, the heating with steam or hot water is immediately followed by cooling with cold water and then with brine, after which the brine is removed and the brine-wet surface remains exposed to the air until the next day's operation, when heat again is applied first and the routine of heating and cooling is repeated.

The results of this treatment showed very much greater corrosion with most of the metals than in the case of treatment with brine alone. They demonstrated the utter unsuitableness of iron and galvanized iron in equipment used for heating and brine cooling. They further show that even ordinary stainless steels are far from immune and yield to profuse rusting. The only metals that proved reasonably resistant to corrosion were superascoloy, nickel silver, and tin. However, tin-coated metals were unable to withstand the treatment satisfactorily.

Discussion of Results.

In the following paragraphs it is endeavoured to briefly summarize these findings by grouping the metals studied according to their all-round merits regarding resistance to corrosion and effect on flavour of milk products under general factory conditions.

Iron, Galvanized Iron and Tinned Iron.—It will be seen from the preceding discussion that iron ranks among the metals of lowest resistance to corrosion in practically every liquid and under every form of treatment that is involved in milk work. Its rapid and intense corrosion during the short period of exposure that prevailed in the several treatments of this experiment is most convincing. In the face of these results the short life of iron equipment in commercial use is not surprising. The unsuitableness of iron is further greatly magnified where it is in direct contact with the dairy product, because its rapid corrosion was invariably accompanied by the development in the dairy product of a very pronounced, intense metallic or putrid flavour, as was also noted by Quam[4], who found that iron caused greater decomposition in milk than any other metal which he studied.

Nor does the coating of iron with zinc or tin furnish a dependable protection. In the case of galvanized iron the great corrosiveness of the zinc itself forfeits the protection expected. In the case of tinned iron a heavy and uniform coating of tin does give satisfactory protection against corrosion, but such perfection of tin coating on iron is very rare. Moreover, the tin coating is porous, inviting access of the media to the easily corroded iron underneath. This provides corrosion centres on which action is concentrated and from which corrosion spreads

rapidly. The damage is further aggravated by the use of strong caustic alkalies for washing purposes, which readily attack the tin. As a convincing example of this fact may be cited commercial experience in the washing of farmers' milk and cream cans with washing solutions of caustic alkalies. Such cans lose their tin coating rapidly, rust profusely, and soon are in a bad and insanitary condition. It is well known, though not fully appreciated, that such cans are responsible for a great deal of the metallic flavour in cream that arrives in American creameries. This situation might be materially improved by the use of washing powders that are known to be less corrosive, such as plain tri-sodium phosphate or tri-sodium phosphate containing a small amount of sodium chromate. There is no question that the factor of rusty cream cans plays a very important role in the production of cream of poor quality.

Copper, Copper Alloys, Tinned Copper, and Tin.—On a par with iron, in its damaging effect on the quality of the milk product, stands copper. This metal has been shown to give milk and cream a most intense tallowy, oily, and metallic flavour. In the experiment here recorded both copper and iron invariably produced these objectionable off-flavours. While the immediate damage to flavour may be slightly less pronounced in the case of copper than with iron, the presence of even very minute quantities of copper salts in the dairy product are capable of producing most intense progressive flavour deterioration in the dairy product with age, due to oxidative and catalytic changes, as shown by earlier work of Rogers,[5] Hunziker,[6] and others.

Recent work by Mattick[7] showed that an oily flavour in milk was very common in England and Scotland, and he attributes this defect to extremely small quantities of copper absorbed into the milk during cooling of the milk by the use of imperfectly tinned copper coolers. Grindrod[8] claims that sterilization of milk and evaporated milk in an apparatus made of copper, brass, or zinc, or containing these metals, causes so great damage to the milk that his process of impact sterilization is a failure for all practical purposes.

The use of vaccum pans, hot wells, forewarmers, holding vats, pasteurizers, and similar equipment constructed in part or wholly of copper, or copper alloys, obviously represents a continuous menace to the quality of the dairy product, and yet such equipment, made of or containing such metals, constitutes the great majority of containers and apparatus used in present-day milk products plants.

The alloys of copper gave evidence of considerably greater resistance to corrosion than copper, and their immediate effect on the flavour of the dairy product was decidedly less pronounced, but appeared in many instances. Nickel silver caused metallic flavour more often than monel metal. However, this experiment demonstrated that neither of these alloys give dependable protection against metallic injury to the flavour of milk products, and these results are fully supported by commercial experience.

The proper tin-coating of copper provides the most effective protection against the corrosion of copper and its damaging effect on the milk product. Properly tinned copper offers a safe surface for exposure

to milk products. Tinned copper furnishes better protection in this respect than tinned iron. Nevertheless, the life of the tin coating on copper is relatively short, and re-tinning at frequent intervals becomes necessary in order to guard against the presence and damaging effect of exposed copper. Even in such weak organic acid solutions as may be encountered in sweet and sour milk products, such as lactic, butyric, citric, and acetic acids, the corrosion and loss in weight was very considerable, both on pure tin and on tinned copper. In a cold .2 per cent. solution of citric acid for instance, the loss ranged from 6 to 9 mgm. per square inch of metal strip.

Further experimental proof of the action of weak organic acids on tin is cited by Mantell and Lincoln.[9] These investigators studied the subject from the stand-point of the food canning industry, and found that citric, lactic and acetic acids attack tin and tin alloys. The life of the tin coating is further shortened by the excessive use of causic alkali washing powders used for cleaning, and hypochloric solutions used for sterilizing the equipment.

Another possible contributing factor to the short life of the tin coating on copper may be the contamination of the tin with copper due to method of tinning. Thus, Merica[10] points out that in tinning copper, the tin bath tends to become contaminated with copper, and there is danger of obtaining a brittle tin coating.

While the solubility of tin in the milk product is not inconsiderable, the salts of tin appear to cause no noticeable injurious effect on the flavour of the milk product. In the present experiment the pure tin proved entirely harmless in this respect. Under no condition, regardless of temperature, acidity or time of exposure of the milk product, was there the slightest suggestion of metallic or other objectionable off-flavour. These results are in harmony with the findings of Donauer[11] who shows that while tin is more soluble than copper, and copper alloys, it required ten times as much tin in solution as copper to produce a distinct metallic flavour. That tin is incapable of inciting progressive decomposition and damage to flavour in butter, while, under identical conditions, iron, copper, and nickel-silver spoiled the butter entirely, bleaching it and making it intensely tallowy in flavour, was demonstrated by Hunziker and Hosman.[12]

These facts may well constitute one of the principal reasons for the great popularity of tinned copper surfaces in dairy equipment. Yet the desirability of the presence in milk products of such metallic salts as the salts of tin may well be questioned.

Nickel.—Nickel has proved to be a very desirable metal in milk work. In the present experiment it was found to be very little affected by alkalies, chemical sterilizers, and brines. It is, however, not immune to the action of acids. In fact, in the several organic acids of milk and in sulphuric acid it proved considerably more soluble than tin. This fact was further substantiated also by its much greater solubility than tin in the milk products, both sweet and sour, and hot and cold. Similar results are also reported by Quam.[13] Particularly noticeable is its ready tarnishing in milk products, which is also observed in the commercial use of nickel dairy equipment.

As far as the effect of nickel on the flavour of the milk product is concerned, the present experiment showed that nickel is not entirely negative. While no intense metallic flavour resulted from nickel in any of the milk products, a slightly metallic and bitter flavour was noted in the case of acidophilus milk, starter, and in sweet cream, hot and cold. The ready solubility of nickel in milk suggests that nickel equipment is not so suitable for high-acid dairy products as is generally expected. Similar observations were also reported by Cornell[14] in his experience with milk plant operations, who concludes that " nickel is not so satisfactorily used in connexion with the development of high-acid in dairy products." Burrell[15] reports that nickel hoops used for draining Camembert cheese were a failure, and actually caused the cheese to turn green, while similar hoops made of stainless steel have proved very satisfactory.

On the other hand, Grindrod,[8] who worked with sweet milk, found that " evaporated milk made in all-nickel or all-tin apparatus was very far superior to the ordinary evaporated milk " (meaning that made in copper vacuum pans). Again, an all-nickel horizontal coil vat installed in one of the factories of the Blue Valley Creamery Co.[16] was used for the pasteurization and ripening of cream. This vat has proved entirely satisfactory as far as its effect on the flavour of cream and butter is concerned. It has been in daily use for a period of over two years, and at no time has there been any indication of metallic flavour in the milk product, although the nickel has lost its original lustre, shows considerable tarnish, and analysis of the cream by Quam[17] disclosed the presence of appreciable quantities of dissolved nickel. Hunziker and Hosman[12] found nickel to be equally satisfactory as tin in protecting butter against progressive flavour deterioration. Prolonged contact of nickel with butter failed to produce metallic flavour in the butter. Because of these facts the conclusion is inevitable, that nickel, similarly as tin, is a desirable metal in milk work, though its even greater solubility than that of tin raises here, too, the pertinent question of the doubtful desirability of the presence of considerable amounts of such metallic salts in the dairy product.

Aluminium.—Our results with aluminium suggest that this metal deserves serious consideration in connexion with milk plant equipment. With the exception of its instability in alkalies, its resistance to corrosion proved superior to that of iron, zinc, copper, tin, and nickel products. In organic acids, brine, sweet milk and cream, and moderately sour milk products, such as sour cream, buttermilk, and starter culture, corrosion and loss of weight were either entirely absent or their extent was very slight. In dairy products of intensely high acidity, however, the corrosion was somewhat more pronounced, and a very slight metallic flavour was discernible. This was noticeable in high-acid cultured milk, such as acidophilus milk. Commercial experience in European milk plants where aluminium equipment, because of its cheapness, is very extensively used, however, developed the fact that aluminium suffers considerable pitting in the presence of milk heated to high temperatures. For this reason, the aluminium equipment in European milk factories is confined more largely to holding tanks, milk pipes, milk shipping cans, and the like. The fact, nevertheless, remains that in the present experiment both aluminium and aluminium manganese alloy showed high resistance to corrosion, and gave no evidence of pitting in milk and cream, hot and cold.

Possibly the greatest draw-back of aluminium and aluminium alloy lies in its lack of resistance to the corrosive effect of alkalies. Experimental observations showed these products to be severely attacked and rapidly destroyed by alkaline washing powders. Similar observations were also reported by Williams,[18] who states that solutions of caustic alkalies and of chlorines rapidly corrode aluminium. The Metals Commission of Berlin[19] thus recommends that pure alkalies and acids must not be used for cleaning this metal.

In this experiment the treatment of sodium carbonate washing powder with a very small amount of sodium silicate reduced the corrosion of both aluminium and aluminium manganese alloy to a mere slight tarnish, while in sodium carbonate alone corrosion was very marked. Thus, in sodium carbonate alone aluminium lost 4.5 mgm. and aluminium manganese alloy lost 7.5 mgm. per square inch, while the addition of 1/20 per cent. of sodium silicate reduced this loss to a gain in weight of .16 mgm. and .1 mgm., respectively, per square inch. Similar treatment was also recommended as highly effective by Churchill[20] and by Seligman.[1]

The silicate treatment of caustic soda and of tri-sodium phosphate, however, failed to protect aluminium from profuse corrosion. In fact, in the case of caustic soda the loss in weight was practically four times greater with sodium silicate than without silicate treatment. In tri-sodium phosphate the silicate treatment also tended to increase rather than decrease the loss in weight while treatment with sodium chromate reduced the loss in weight about 60 per cent. However, in both treated and untreated tri-sodium phosphate, the aluminium and aluminium manganese alloy became coated with a very heavy jet-black tarnish which condemns the use of tri-sodium phosphate as a cleaner for aluminium.[2]

In sodium brine treated with sodium silicate, corrosion and loss in weight were exceedingly slight and the same brine treated with sodium chromate in the place of sodium silicate, had no effect on aluminium, aluminium alloy, and aluminium-plated alloy. There was no corrosion, no tarnish, no discoloration and no loss in weight.

Another important factor greatly influencing the resistance of aluminium to corrosion in milk equipment is the physical state and purity of the metal. Thus, wrought aluminium, which is usually of relatively high purity, has been found to withstand attack far more readily than cast aluminium, which generally contains greater quantities of impurities. Seligman[1] points out that while tanks, cans, &c., made of sheet aluminium may be found unchanged after many years of use, cast fittings attached to the same containers may give out after a few years' use. The cause of the short life of the cast metal in all probability lies in the presence of impurities, thus providing the necessary elements for the formation of electrical couples and giving rise to galvanic action. For similar reasons, contact of pure aluminium with other metals intensifies solution and pitting of aluminium, and, as Seligman[1] suggests, the seriousness of the corrosion in such cases is intensified by the fact that the corrosion and pitting is often highly localized. The relative softness of aluminium is an additional objection, particularly when

subjected to rough handling. This suggests the advisability of heavy construction, especially in the case of large equipment.

These several drawbacks, while serious, may be readily minimized, if not entirely eliminated, by intelligent study of the properties of this metal, and by suitable construction and proper use of the equipment. Its cheapness, lightness and comparative inertness in contact with the milk product recommend its more serious consideration in milk work in this country.

Chromium Steels.—The chromium steels, as a group, showed very high resistance to corrosion. There was, however, some difference between the individual chromium steels. Superascoloy, the chromium-nickel-steel, showed marked superiority over the ordinary chromium steel alloys, ascoloy and enduro. In fact, superascoloy ranked best of any of the metals under study. Where there was absence of corrosion in the case of several of the other metals, superascoloy invariably also proved entirely immune. In liquids and under treatment that caused serious corrosion of the other metals, superascoloy was either not affected at all, or led the list in point of resistance to such corrosion.

In only two cases did superascoloy show visible attack. One of these was successive exposure to steam, brine and air for seven days, and even here the corrosion was exceedingly slight and far less than in the case of any other metal. The other instance refers to treatment in hydrochloric acid, and here, again, the corrosion was much less than that of the other metals, with the exception of aluminium-plated alloy and nickel, which lost only slightly more in weight than superascoloy. In no case did superascoloy injure the flavour of the milk product.

Ascoloy and enduro closely followed or were equal to superascoloy in most cases, as far as visible corrosion and loss in weight is concerned. This was true for sweet and sour milks and creams, washing powders, disinfectants, most of the brines and the organic acids. In hydrochloric acid and sulphuric acid both ascoloy and enduro corroded very profusely, lost greatly in weight and dropped to the bottom of the list, together with zinc and iron. This suggests that when these chromium steels begin to yield to corrosion they may become intensely affected, corroding and pitting very rapidly. This fact was further emphasized by their lack of stability under successive steam, brine and air exposure. Furthermore, in high acid milk, such as acidophilus milk, both ascoloy and enduro produced a slight metallic flavour. Whenever these two alloys suffered corrosion the enduro proved slightly more resistant than the ascoloy. It was also noted in the case of enduro that the highly polished surface resisted corrosion considerably better than the unpolished back side. Because of these weaknesses, these ordinary chromium steels cannot be considered dependable metals for use in all milk equipment. For this reason they must be looked upon as less suitable than tin and nickel which, according to these results, rank next to superascoloy. These observations are also supported by the work of North.[21] An analysis of his figures shows that superascoloy ranked first and was closely followed by nickel and enduro. Quam[13] also compared the resistance of three chromium steels, and found the superascoloy far superior to the ordinary chromium steels. Burrell[15] found chromium steel cheese vats very satisfactory.

Grindrod,[8] who, before the advent of superascoloy in milk equipment, considered all-nickel and all-tin the only metals suitable, reports that superascoloy has proven fully equal, and in some respects superior to, nickel in the construction and use of milk condensing and sterilizing equipment. Dahle[23] states that he used a superascoloy tank repeatedly for making pure culture milk with an acidity of 1 per cent. and noticed no spots or discoloration on the metal, nor any off-flavours in the milk. MacQuigg[24] reports that high-chromium steels and chromium-nickel steels showed greater resistance to corrosion in the handling of corrosive chemicals than any other metal or alloy.

These results and experiences place superascoloy at the top of the list of suitable metals in milk work. In accepting this high ranking of superascoloy the reader should take cognizance of the fact that chromium steels are vulnerable and may suffer intense rusting and pitting when in contact, on the milk side, with certain other metals. Users of chromium steel tanks have learned that when such equipment contains rivets, bolts, fittings or other accessories of such metals as iron, copper, nickel silver, monel metal, &c., the resistance of the chromium steel to corrosion may be materially diminished and rust spots may appear. Rusting may also occur on welded surfaces of chromium steel in the absence of proper finishing of the weld, such as will remove all traces of iron oxide that may have formed during the welding process.

Combinations of Metals.—The presence of two or more metals in the same piece of dairy equipment is fundamentally undesirable. Most metals used may differ in their electrical potentials, and this in turn invites corrosion by electrolysis. For similar reasons, impurities in metals are equally objectionable, as was pointed out in the case of cast aluminium. The corrosion-inciting effect of contact with other metals in the case of aluminium and chromium steel equipment, has already been explained under the respective heading of these metals.

Certain alloys have proven unsuitable for milk work because they, too, provide the elements for the presence of electrical couples. This appears to be especially the case with copper alloys, such as nickel silver, and to a lesser extent monel metal. When these alloys corrode the metal that goes in solution is usually found to be the copper. It is well known by the metallurgist that in the case of nickel silver, for instance, segregation may take place during the cooling of the molten alloy, thus resulting in the formation of electrical couples which, when submerged in the milk product, may incite electrolysis. The same situation prevails in equipment consisting of metal-coated surfaces, such as tinned iron, galvanized iron, tinned copper, whenever these coatings become defective, and cause exposure of the metal underneath the coating.

These facts emphasize the importance of avoiding multiplicity of diverse metals in one and the same piece of equipment, of confining the construction of mechanical accessories and fittings that come in contact with the milk, as completely as possible to the metal of which the milk side of the equipment consists, or if different metals must be used, of giving preference to metals of similar electrical potentials. Emphasis should further be placed on the importance of purity of the metal used, the undesirability of copper alloys, and the necessity of keeping the coating of covered metals intact by recoating when the base metal becomes exposed.

While, for above reasons, the presence of more than one metal immersed in the milk product is undesirable, there are instances when the introduction of a second metal may not only be harmless, but may actually be beneficial in that it may assist in retarding corrosion of the metal it is desired to protect. Thus, Quam[13] points out that aluminium manganese, zinc and wrought iron materially retard the corrosion of nickel and tin. Burrell[15] and McKay[25] likewise report that aluminium noticeably prevents the discoloration and pitting of nickel. In these cases galvanic action is utilized to protect the other metal against attack.

Toxicity of Metals.—This experiment did not include the toxicological aspect of metals. The scarcity of comparable and tangible data available renders a discussion of this subject difficult. There appears to be no established standard of toxicity on the basis of which the several metals herein considered may be compared with reasonable accuracy. It is generally conceded that salts of such metals as chromium, copper, zinc, and tin are highly poisonous. Their solubility in milk work, therefore, is a factor of considerable importance, and the use in dairy equipment of those metals of toxic properties of which large amounts go into solution may be considered a questionable practice. This would apply both as regards their direct physiological effect on the human system, as well as their inactivating influence on the valuable milk vitamins.

Summary.

An experiment was conducted to determine the suitability of 10 different metals for use in milk plant equipment. The effect of milk and cream, sweet and sour, and hot and cold, of dilute organic and mineral acids and of washing powders, chemical sterilizers and calcium and sodium brines, on visible corrosion and loss of weight of metal strips, both totally and partly submerged was noted. Likewise, the influence of these metals on the flavour and character of the milk products was studied.

The results suggest the following classification of the metals studied with reference to their suitability for general use in dairy equipment from the standpoint of resistance to corrosion and effect on milk products—

(1) Superascoloy, tin, nickel.

(2) Tinned copper (heavily tinned), aluminium and aluminium manganese alloy, enduro and ascoloy.

(3) Monel metal and nickel silver.

(4) Tinned iron, copper, galvanized iron, iron, zinc.

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* *Addendum.*—Since the conclusion of this experiment the designation "Superascoloy" has been changed to "Allegheny metal".

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SALADS.

By Miss A. Knight, Fruit Preserving Expert

At this time of the year, when the warm weather is approaching, salads are much appreciated. A good salad should suggest something cool, appetising, and inviting in appearance. Almost all varieties of fruit and vegetables may be utilized for this purpose. Some in a raw state; others when they are cooked.

With most stem and leaf vegetables (as celery, lettuce, cress, &c.), both texture and flavour are best when the plants have made quick growth. At the present time, nice, crisp leaf vegetables are obtainable at a reasonable price.

It is important that raw vegetables, when employed for this purpose, be very fresh and crisp. Limp vegetables will never make a successful salad. Where possible, they should be used very soon after gathering, as they are then at their best; but this is difficult unless one has her own kitchen garden. If not freshly cut from the garden, they should be freshened and made crisp by immersion in cold water, but they should not be left in the water for a longer period than is absolutely necessary to revive them.

Most salad plants grow with their leaves close to the ground, and it is very important to thoroughly cleanse them, so as to free them from sand, insects, &c. After washing, it is then necessary to remove any surface moisture from the leaves, so that the dressing will adhere to them. To do this, they should be shaken in a salad basket after cleansing in the water (a wire frying basket will do if a salad basket is not at hand), then tossed lightly in a loosely-woven towel, or in a square of butter-cloth. In this way, the leaves are made sufficiently dry to receive a coating of any desired dressing. The salad is improved if, at this stage, it is set on ice for a little while, so that it is thoroughly chilled before serving. The plates also should be made quite cold

The dressing generally preferred for a light salad of greens is, perhaps, the well-known olive oil and vinegar dressing, although many like a cream dressing. It is essential to have olive oil of the very best quality, and cider vinegar, or else a good white wine vinegar should be used. Usually two parts of olive oil, to one part of vinegar is allowed, and the average quantity required for each small head of lettuce is about one tablespoon of oil and half a tablespoon of vinegar, and a pepper and salt seasoning. The usual method of applying the dressing is to place the chilled leaves in the salad bowl; sprinkle them with the salt and pepper; and then add the oil. Turn the leaves about so as to coat the surface evenly with the oil; then add the vinegar, and give the salad a final light toss in the dressing. It should be served immediately. Sometimes a very slight flavour of mustard is liked with this class of dressing; and if so, it may be dissolved or moistened in the vinegar.

Tastes differ very much with regard to salads and salad dressings, and many prefer a light cream dressing to that of oil, even with a lettuce salad, and many fancy a sweetened dressing. Some like a finely cut salad, but the most important point is to keep the greens crisp, fresh, and attractive in appearance.

Most raw salads are improved by the addition of some member of the onion family, even though it be very mildly flavoured. The onion may be either sliced, grated, or, if preferred, the juice only may be used, or it is sometimes preferable to steep the cut onion in the vinegar for a short time, so that it is delicately flavoured. This, however, is entirely a matter of taste.

The flavour of any salad dressing may be varied considerably by using differently flavoured vinegars. These make a pleasant change and may be prepared in the home, and kept in small corked bottles ready for use when required. Such flavours as those liked for clear pickles are generally chosen for salads. Vinegars left over from pickles are very good for the purpose. They may be sweetened with sugar, if desired, and then are always ready. Cream, either fresh or sour, may always be substituted for oil in any dressing, and lemon juice may be used instead of vinegar; it usually gives a whiter dressing.

The consistency of the dressing will chiefly depend on the kind of salad with which it is to be served. The mayonnaise, cream, or boiled dressings, may be made thick enough to mask a cooked salad, while, if preferred, they may be made thinner by the addition of thin cream or milk.

A nice dressing is made something like this:—

2 tablespoons of light vinegar
Yolk of 2 eggs
½ teaspoon of mustard (mixed with a little of the vinegar)
A little salt and pepper and, if liked, a trace of cayenne
1 rounded tablespoon of sugar
1½ to 2 tablespoons of butter
½ pint of cream.

Beat the egg yolks slowly, then add the butter, sugar, and seasoning; cook in a double boiler until a smooth sauce is made, then allow it to become cold. When required for use, beat in the cream. If the cream be whipped stiffly, a thicker dressing will result. If a thin one is wanted, use the cream unwhipped.

Cream is not always obtainable, and hereunder is a recipe in which condensed milk is included:—

4 tablespoons condensed milk (unsweetened)
1 level teaspoon mustard
Pepper and salt to taste
2 dessertspoons of vinegar or lemon juice
2 dessertspoons of sugar (if sweetened condensed milk is used, omit the sugar, or reduce the quantity).

The following is a recipe for mayonnaise sauce, suitable for a cooked salad:—

Yolks of 2 eggs
2 tablespoons of olive oil.
2 dessertspoons of vinegar (flavoured, if desired)
1 teaspoon of hot chilli vinegar
½ teaspoon of salt
½ teaspoon of made mustard
½ teaspoon of sugar (may be omitted if preferred)
trace of cayenne.

To make this sauce, put the egg yolks, salt, pepper, mustard, and sugar into a basin, and mix them thoroughly; then add the olive oil gradually stirring all the time until the mayonnaise is thick, but do not make it too thick. Then gradually add the vinegar. More or less vinegar may be added, according to taste and the nature of the salad to be dressed. This dressing will keep well for a week or so if stored in a cool place. Where a drop bottle is not available, a good idea is to cut a groove in the side of the cork, so that the oil may be dropped, or poured very slowly.

An economical salad may be made by utilizing meat and vegetables which have been left over from the dinner. For example, put a layer of shredded lettuce on a plain, white, oval dish, and make a pyramid in the centre of nicely cooked, tender meat, ham, or poultry, and season it with pepper and salt. Cut any cold vegetables that are liked, such as cauliflower, peas, haricot beans, &c., also raw tomatoes, cucumber, &c., and arrange them nicely around the meat. Make a nice dressing and pour over, then decorate with rings of radish, beetroot, pickled gherkins, or the tender foliage of the celery. New potatoes make a nice addition to a salad of this kind, but old potatoes should be avoided.

Certain kinds of fish, as salmon, lobster, oyster, and any other variety having a firm flesh, are also suitable for combining with greens in salads, and may be attractively decorated with sliced lemon, or other suitable garnish.

A few other nice mixtures well worth trying are:—

Cooked asparagus tips and peeled raw tomatoes.
Cooked asparagus tips and cooked cauliflower.
Pickled beetroot and fresh onion.
Beetroot and celery.
Celery and cucumber.
Apple, onion and celery diced.

STALLION REGISTER 1928-29,

under the Horse Breeding Acts 1919 and 1925.

Part III.*– Registrations after 1st October and prior to 1st November, 1928.

Cert. No.	Name.	Age.	Class.	Owner.	Address.
		Yrs.			
764	Baron Brilliant ..	A	Draught ..	M. P. Murphy ..	Rupanyup
756	„ King ..	3	„ ..	W. Watts ..	Kamarooka
800	„ Watson ..	A	„ ..	J. L. McErvale ..	Brewster
801	Bazil B. ..	A	Light ..	W. A. Riedell ..	Tongala
787	Bold Lad ..	A	Pony ..	Master A. A. Wall	Rushworth
779	Bonnie Star ..	3	Draught ..	E. S. Gillespie ..	Rockbank
788	„ Voyage ..	A	Light ..	J. E. Tanner ..	Barnawartha
789	Bournie Alto ..	A	„ ..	Miss E. Caldwell	Bendigo
760	Capitalist ..	A	Draught ..	A. K. Urquhart ..	Hexham
759	Count Rhymney ..	A	Pony ..	Bourke Bros. ..	Monomeith
752	Cronje Wilkes ..	A	Light ..	G. B. Mackie ..	Camperdown
763	Don Marvin ..	A	„ ..	J. Wilson ..	Carlton
765	Earlsan ..	A	Thoro'bred	E. L. Johnson ..	Cassilis
771	Favourite Lad ..	6	Draught ..	C. E. Gomm ..	Somerville
766	General Scotch ..	A	„ ..	C. Quarrell ..	Red Cliffs
790	Kerrsdale ..	4	„ ..	E. Wilson ..	Leongatha
791	Kilmore ..	A	„ ..	W. Gribenoe ..	Orbost
784	Last Thought ..	3	„ ..	F. W. Bowden ..	Won Wron
768	Little Mac ..	A	Pony ..	W. B. Cumming	Darlington
762	„ Pos ..	A	Thoro'bred	A. K. Urquhart ..	Hexham
792	Lord Dale ..	6	Draught ..	H. Miller ..	Bacchus Marsh
802	Lord Fabric ..	6	„ ..	E. T. Bail ..	Torrumbarry
793	Lu Lu's Dandy ..	A	Pony ..	W. Milligan ..	Kerry P.O.
777	Lyndale ..	A	Draught ..	D. Blair ..	Buckrabanyule
773	Middlemarch ..	A	„ ..	M. J. Egan ..	Charlton
767	Montrae Rold ..	A	„ ..	W. Pizer ..	Kyneton
786	Newton's Moddle	5	„ ..	C. W. McClay ..	Mallan, N.S.W.
780	Onward Kennedy	4	„ ..	W. L. Thompson	Karramomus
803	Opera Boy ..	4	Light ..	J. Guidice ..	Kangaroo Flat
761	Palos	A	„ ..	R. Warren ..	West Moolap
769	Prince Wighton ..	A	Draught ..	W. Studman ..	Bairnsdale
781	Pride of Clutha ..	A	„ ..	J. Lingenberg ..	Foxhow
785	Quarrington Lad ..	5	„ ..	F. Branson ..	Lake Cooper
757	Red Lion ..	A	Pony ..	G. H. Whitehead	Minhamite
772	Right Dale ..	A	Light ..	O. T. Ovens ..	Tatura
770	Sampson ..	3	Draught ..	E. R. Morton ..	Drouin
775	Scotchie ..	A	„ ..	I. Kelly ..	Korong Vale
755	Scotland Again ..	5	„ ..	A. McDonald ..	Mt. Wallace
794	Scotland's Fancy ..	A	„ ..	T. Daffy ..	Swan Marsh
774	Shandon Bells ..	A	Light ..	A. T. Darling ..	Linton
795	Shepherd ..	A	Draught ..	R. N. Dunn ..	Rupanyup
778	Tinylights ..	A	Pony ..	E. E. Small ..	San Remo
796	Wee Key ..	A	„ ..	R. Kirkwood ..	Hamilton
754	Western Lad ..	A	Draught ..	J. and C. Ross ..	Lake Bolac
797	White Prophet ..	A	Thoro'bred	R. W. Cooper ..	Berwick
799	Widgiewa Fashion	A	Draught ..	W. L. Oliver ..	Diggora West
776	Widgiewa Norseman	6	„ ..	Wilkinson and Young	Yarrawonga
753	Wiltshire ..	A	Light ..	W. G. Nimmo ..	Banyena South
758	Xantho ..	6	Thoro'bred	J. C. Whitehead	Minhamite
798	Young Major ..	A	Draught ..	J. Gould ..	Boort
783	Young Recruit ..	A	Pony ..	E. W. Waters ..	Echuca East

* For Part I. see this *Journal* for August and for Part II. this *Journal* for October, 1928.

Part V.—List of stallions in respect of which certificates of registration have been refused but which, the owners having paid the prescribed fees, may be retained for breeding purposes with owners' own mares only. Registrations from 1.8.28 to 31.10.28.

Name.	Age.	Class.	Owner.	Address.
	Yrs.			
Balmont ..	4	Draught ..	R. A. Perkins ..	Rainbow
Baron Jack ..	3	,, ..	Lynch and Pickering	Hopetoun
Bonnie Lad ..	14	,, ..	R. Jones ..	Tatong
Bonnie Stamp ..	3	,, ..	Estate of D. Mitchell	Lilydale
November ..	4	Light ..	Ramage and Mason	Violet Town
Royal Baron ..	5	Draught ..	D. Lamb ..	Geelong
Scotty	5	,, ..	W. J. Hand ..	Willenabrina
Young Advance ..	6	,, ..	T. Hahnel ..	Speed
Young Maritimas ..	3	,, ..	W. M. Rowan ..	Kyneton

DAIRY INDUSTRY IN IRELAND.

Plans for Development.

The re-organization of the dairy industry which the Irish Free State Government has now undertaken, in conjunction with the Irish Agricultural Organization Society, is the biggest direct effort which the Government has made on behalf of Irish industry, says the Dublin correspondent of *The Manchester Guardian and Commercial.*

The full text of the article is as follows:—

"Of the 580 creameries in the Free State 400 are co-operative and 180 proprietary. A disastrous trade war has prevented the development of the industry in recent years. In some districts creameries have competed for milk supplies, and have also competed in the export butter market. Not only have the co-operative and the proprietary creameries fought each other, but a struggle has gone on between the co-operative creameries themselves. Outside buyers could always get four or five different quotations from creameries in the same district, while butter has been consigned in small lots from different points by different routes. In these circumstances no proper arrangements for transit could be made. Carrying companies could not provide cold storage and other facilities needed. Denmark, with its superior organization, supplied 28.3 of the English demand for butter in 1925, while Ireland supplied only 6.9.

To remedy this the Agricultural Organization Society negotiated with the larger proprietary interests, and in November, 1926, presented a memorandum to the Government stating that the Condensed

Milk Company of Ireland was willing to sell its interests, and asking the Government to furnish the necessary credits. The Government decided to support the society's scheme for the elimination of proprietary concerns, which is now being carried out. At present the operations concern the Condensed Milk Company, which includes Cleeves Ltd., and the Newmarket Dairy Company—the largest shareholders being Messrs. Lovell and Christmas, of London. This concern, with assets amounting to £350,000, controls 114 out of the 180 proprietary creameries.

The Government is not only furnishing the credits, but is making a grant of from £50,000 to £60,000 towards the purchase money. This, it is calculated, will cover the loss involved in shutting down "redundant" creameries, for, as Dr. Hogan, Minister for Agriculture, has said, it is not practicable that the farmers should bear the whole loss. Where, however, the closing of proprietary creameries means that existing creameries benefit by an increased milk supply they are to contribute on the basis of this increase. In districts where no co-operative creamery exists the milk suppliers are to form a new one, and this will take over the proprietary concerns. In districts where co-operative creameries already exist, non-redundant proprietary concerns will be taken over by the societies. In each case the full purchase price will be paid. The Government is operating through the Dairy Disposal Company, which has been set up to act as vendor. It is by means of this machinery that the proprietary interests will be transferred to the co-operative movement. The co-operative creameries will undertake liability to the extent of £150,000 to £160,000, and in return will have complete control of the whole creamery business in Ireland.

The next step is to reorganize the co-operative movement itself. A Creamery Bill has been introduced which enacts that every milk supplier is to be a shareholder in the creamery society. Sometimes these societies have been formed by a minority of farmers who have accepted the financial responsibility. Now, both the obligations and the benefits are to be spread out. To prevent the industry slipping back into the old haphazard position, the Bill declares that no creamery shall be set up in any district without a Government licence.

A co-operative Act is to be passed covering the whole field of co-operative activities. Under this each creamery will have its area of operations defined, and all creameries must be affiliated to the central body, the Agricultural Organization Society. A supplementary Act will provide for an agricultural credit corporation. This has been long overdue. It is recognized, however, that credit machinery must rest on the basis of efficient production, which the new scheme makes possible. When redundant creameries are closed and re-organization takes place, it is estimated that between £35,000 and £40,000 a year will be saved in overhead expenses. The creameries will be able through central machinery to deliver in bulk and to standardize the butter at its highest quality. It is hoped that they will more than hold their own in competition with Denmark, Holland, and New Zealand."

CO-OPERATIVE MARKETING OF APPLES IN CALIFORNIA.

Mr. E. C. Merritt, manager of the Sebastopol Apple Growers Union, gave a talk before the meeting of the American Institute of Co-operation at Berkeley, California, in July last, on the results of co-operation in marketing apples, which is summarized hereunder:—

"With thirteen marketing organizations handling the Gravenstein apple crop of Sonoma and Napa counties in 1926, returns to the growers were far from satisfactory, and the highest returns were close to the cost of production and below what it would seem were justified by conditions. As a result, the California Gravenstein Apple Growers was formed, controlling 96 per cent. of the crop, a clearing house plan to promote orderly marketing and to eliminate disastrous competition.

Growers are signed for a fifteen-year period, with an annual withdrawal interval. Growers are organized in separate units, according to the selling agency through which they wish to market. Each unit elects a director, but it is provided that the total vote of directors representing commercial units shall at no time exceed the total vote of directors representing co-operative units.

The clearing house is made a part of the general scheme, and is composed of representatives of the different selling agencies, together with an equal number of growers appointed by the directors of the central body. The selling agencies also sign a fifteen-year contract.

The plan worked out well last year. The buyers were given assurance that their markets would not be crowded and that prices would not be decreased. Speculators were not interested at the figures quoted, but the auction markets held up well and averaged better than the minimum prices set by the association.

No one questions the success of our organization this year or expresses doubt as to the future. We realize, of course, that we operated last season under extremely favorable conditions, with a less than average crop of our own, a shortage of competing fruits and the purchasing power of the consumer in most sections at a high level. The real test will come when conditions are the reverse.

It has been demonstrated, however, that controlled distribution and a combination of distributing agencies means net returns of some 25 cents to 50 cents per box more to the grower than divided selling effort and conflicting distribution, whether conditions beyond our control make prices high or low. We have to a certain extent regained the confidence of the trade. The effect on the industry as a whole has been most beneficial. Relations between competing shippers have been improved. Growers not only are satisfied and confident of the future but are becoming better acquainted with their problems and more willing to work together for the common good.

We believe, over in our part of the State, that our new organization, the California Gravenstein Apple Growers, has made an important contribution to co-operative marketing."

ORCHARD AND GARDEN NOTES.

E. E. Pescott, F.L.S., Pomologist.

The Orchard.

Spraying.

The spray pump should now be in thorough working order, so that the various spring sprayings may be carried out with as little interruption as possible. It is always wise to clean out the pump after each spraying, so that it will be ready for the next mixture. Putting a different spray in a pump barrel that has not been washed out very often causes the formation of a sediment, which blocks the nozzle and interrupts the work.

During November it will be necessary to spray for codlin moth, peach aphis, pear slug, and various leaf-eating insects. In addition, black spot of the apple and pear, shot hole, and other fungus diseases must be kept in check. As various sprays are required for all of these troubles, the necessity of always having a clean pump is evident.

At the present time the best spray for peach aphis is nicotine sulphate, and the same spray may also be used for the pear slug. Arsenate of lead is the better spray for this latter insect, but it should not be used when the fruit is approaching the ripening stage; hellebore may also be used for the slug with good effect.

As a preventive against codlin moth, the trees should be kept well sprayed with arsenate of lead. The first spraying should have been given at the time of the falling of the petals; the second spraying, owing to the rapid expansion of the fruit, should be given a fortnight later. After that the grower must use his own judgment as to the necessity for subsequent sprayings. If the moths be at all prevalent, other sprayings will be quickly necessary.

As the woolly aphis is increasing at this time of the year, it will mean a saving of a large number of buds if this insect be sprayed. Nicotine sulphate, pine spray, or lime sulphur may be used with good effect.

Cultivation.

The work of ploughing and harrowing should be completed immediately. All crops for green manure should be now under cover, and if the orchard soil is at all heavy or stiff, the grower should make up his mind to grow a crop next season, in order that this condition may be reduced.

The orchard should be kept free from weeds, not only for the conservation of moisture, but in order to do away with all hiding places of the Rutherglen fly, cutworm moths, &c.

General Work.

Grafted and newly-planted trees should be frequently examined, and given an occasional watering and overhead spraying, in order to encourage their growth, and to prevent loss of moisture from the foliage. It is also advisable to mulch young trees with light grass, or straw mulching not too rich in animal manure.

The disbudding of unnecessary shoots and the pinching back or stopping of growths, to prevent their becoming unduly long, may now be carried out. This work is particularly important on young trees.

Graft ties should be examined, and the ties cut wherever any growth is being made. Where the grafts are likely to make any long growth, they should be well staked and tied.

Citrus trees may be planted out, and, after planting, they should be watered and mulched.

The Vegetable Garden.

Tomato plants should now receive attention every day; laterals will require pinching back; crowded bunches and shoots should be thinned; the plants should be well tied to the stakes, and liberal supplies of water and manure should be given. One or two more plantings of tomato plants may still be made, so that there may be strong, sturdy plants for the production of late fruits. By planting three or four successions of plants, it is possible to have a good supply of fruits from December to June. Pull up and burn all plants showing any signs of disease.

Celery may now be sown for winter crops. French beans should be largely sown. Cucumber, melon, pumpkin, and all seeds of this family may now be sown in the open.

Where these plants are already growing, the longest and strongest runners may be pinched back, to throw the strength into flowering and lateral growths. Watch the plants for mildew, and use sulphur freely wherever present, especially on the young plants.

Peas, lettuce, radish, turnip, cabbage, and sweet corn seeds may be sown this month. Seedlings from former sowings may be planted out, and it would be well to dip the whole plant in water before planting. This greatly assists the young plants while taking hold of the soil in their new location.

Frequent waterings and frequent cultivation will now be necessary; and all weeds must be hoed or hand-weeded out; mulching with stable manure will greatly assist the plants.

A few beds should now be deeply worked, adding a liberal dressing of stable manure. These plots will then be ready for the celery, cabbage, and other seeds planted during this month.

The Flower Garden.

Continue to plant out the various bedding and foliage plants, corms of gladioli, and seed of such tender annuals as Phlox Drummondi, balsam, zinnia, nasturtium, celosia, aster, cosmos and portulaca.

While seeds planted out in the open germinate and grow fairly well, it is advisable during the summer months to plant these in sheltered seed beds, or in a canvas or calico frame. The protection need be on the one side only, preferably the west or north-west; the seedlings are then protected during the hottest part of the day. At the same time the shading should not be sufficient to unduly "draw" them.

The seeds should not be deeply sown, and all waterings should be light. A little water, often, should be the rule for seedlings. Annuals require plenty of room when planted out in the garden. Being quick growers, they are generally gross feeders, and they must have space to develop a good root system. Feeding, too, with liquid manure is helpful when they are reaching the flowering stage.

Dahlias may now be planted out, either from tubers or from young rooted cuttings. These will give good early summer blooms. For autumn and show blooms, the planting should be deferred until the middle of December.

Herbaceous and succulent plants should be staked for protection; included in this section are delphinium, gladiolus, perennial phlox, rudbeckia, &c. These plants will all benefit from liberal mulchings and watering with liquid manure when approaching the blooming period. Spring flowering bulbs, corms, and tubers should now be lifted and stored.

The soil surfaces will now benefit from frequent hoeings and stirrings. Constant waterings will be required if the weather be hot or windy. the cultivation should quickly follow the waterings in order that the moisture may be thoroughly conserved. Mulching with stable manure is also beneficial at this season.

REMINDERS FOR DECEMBER.

LIVE STOCK.

HORSES.—All farm horses in constant work at this season should be well fed with last year's chaff or a mixture of old and new, to which a liberal supply of oats has been added. New chaff or hay alone is not recommended, as it has not the sustaining powers of old hay, and is liable to give rise to digestive troubles. Horses require water at frequent intervals; keeping them for a long time without water, and then allowing them to drink to excess is injurious.

An occasional feed of green stuff will be beneficial. In the event of this being unobtainable, give at week-ends a bran mash, to which is added five or six packets of Epsom salts.

Mares which are away from foals for any length of time should have a portion of milk taken from them before foal is allowed to run with them, otherwise serious results may accrue to foal. Good results follow an allowance of chaff and oats to mares and foals running in paddocks, more especially where feed is short.

At this season the Bot Fly is about, and horses should be frequently examined for the eggs of this fly. The neck, forelegs, and jaws are the parts where the eggs are deposited. Either the use of the singeing lamp under affected parts or the application of kerosene will destroy the eggs.

Cattle.—Provide succulent fodder and plenty of clean water and shade. The silo is the cheapest method of providing succulent fodder, silage costs less than 10s. per ton to grow and save. Mow and make hay of as much grass as possible. This will keep indefinitely so long as it is protected from the weather. Mice will not work in it. Limewash the cowbails, it helps to keep down flies. Provide "lick" in trough, consisting of salt 40 lb., bone flour 20 lb., lime 25 lb., sulphur 15 lb., pot. iod. 5 oz. Look out for milk fever. Write for Department leaflet. Have cows' milk weighed and tested for butter-fat. Rear heifer calves from cows giving satisfactory results. Continue giving milk at blood heat to calves. Be careful to keep utensils clean, or diarrhœa will result. Do not give too much milk at a time for the same reason. Give half a cup of limewater in the milk to each calf. Let them have a good grass run or lucerne, or ½ lb. crushed oats each per day in trough. Dehorn all dairy calves, except those required for stud or show purposes.

Pigs.—*Sows.*—Supply those farrowing with plenty of short bedding in well-ventilated sties. Those with litters old enough may be turned into grass run. *All* pigs should be given a plentiful supply of clean water. Read Bulletin No. 16. Pig raising and fattening with present price of pollard and bacon should be profitable.

Sheep.—Shearing should now be over except in the case of a few late lambs in the wetter parts of the State. All faulty-mouthed ewes should be disposed of as fats; if not fat they should, if possible, be fattened for sale. Inferior-fleeced ewes should also be sold.

December, January, February, and March are the joining months, the time varying with climatic conditions of different districts. Lambs will be dropped 150 days after service. It is a mistake to try to lamb down early in the later districts.

Leave the rams with the ewes for seven weeks in case any ewe should come into season a second time. For a good percentage a second mating is sometimes necessary. Join 2 per cent. of two-tooth, four-tooth, six tooth, and eight-tooth rams, or 3 per cent. of older rams with the flock; with fine-woolled Merino rams 3 per cent. of two-tooths is advisable. Rams should be in good condition. Pare their feet and clean wool and burrs from around eyes and pizzles before joining.

Breeding ewes should be of one breed or cross, and should be culled, so that the wool of the progeny will be as even in quality as possible. This precaution would also ensure an even dropping of lambs. Merinos and fine-woolled ewes come into season first; half-bred and strong-woolled crosses later; all sheep with a preponderance of British blood are even later still. It is useless to join rams with ewes until their proper time for coming into season. Rams may be active, but ewes will not conceive until in season.

Preparation should be made for dipping, and this important operation must be carried out. Mix dip thoroughly and in the manner indicated in directions. Be sure the sheep are not over-heated when dipped. If possible, dipping should not be done during hot weather.

Poultry.—Add a little pearmeal to morning mash and give less bran. Feed equal parts wheat and heavy oats at night. Supply plenty of green food—at this time, lettuce is invaluable. Avoid salt meat of any description. Keep ample supplies of sand, ashes, &c., in pens, and moisten same. This will enable the birds to keep themselves cool and clean. Top off geese, ducks, and cockerels for the Christmas markets. Hens will do better this month by having free range. Remove all male birds from flocks, as infertile eggs will keep longer and command a higher price.

CULTIVATION.

Farm.—Cut hay in late districts. Cut oats and barley in early places. Finish planting potatoes. Put in late maize for fodder, also millet and imphee. Plough fire-breaks where required. Get stackyard and stages ready for hay.

ORCHARD.—Keep the surface loose and free. Suppress weeds. Spray as often as necessary for codlin moth and pear slug. Mulch and spray young trees and grafts with water in the early morning during hot weather.

VEGETABLE GARDEN.—Keep the surface hoed, and allow the plants plenty of moisture. Stake, pinch out, manure, and water tomatoes. Pinch back long runners of pumpkin and melon family. Sow autumn and winter varieties of cabbage and cauliflower. Plant out seedlings in cool weather. Sow French beans. Cease cutting asparagus beds, and top-dress with manure.

FLOWER GARDEN.—Plant out dahlias and gladioli for autumn blooming. Lift and store spring flowering bulbs. Stake, tie, and train growing plants. Sow zinnias and asters. Layer carnations, camelias, daphnes, &c. Water well and keep the surface loose. Keep rose beds fairly dry.

BEE-KEEPING.

December is the month for the main honey flow from yellow box and red gum Swarming is practically over for the season except, perhaps, in late districts Where there has been more swarming than the owner of the bees desired, and the total yield of honey is the object aimed at rather than increase in the number of colonies, the weaker stocks may be united at the commencement of the honey flow, as the highest return is secured by having a given number of bees in the fewest possible number of hives; that is to say, 50,000 worker bees in one hive will store a far greater amount of honey than the same number in two hives with 25,000 bees in each. Such a large worker-force requires three bodies of full-depth frames, otherwise the best results cannot be obtained, because nectar being as thin as water when brought in by the bees, only a little is put into each cell to hasten evaporation. When, therefore, sufficient empty combs are not available to the bees, part of the worker-force will be idle.

Each colony should have at least three sets of Langstroth size combs, and when these are not available the time of the red gum honey flow is suitable for getting new combs drawn out from full sheets of foundation. Comb foundation is expensive, but in the end combs built from starters are more expensive still, because so much drone comb is built when starters only are given, that one of the principal advantages of the frame-hive system is lost.

All frames should be wired, four horizontal wires being most in favour with beekeepers; the wires should be well embedded into the foundation so that it may not come away from them. Between the bottom edge of the sheet of foundation and the bottom bar of the frame there should be a space of at least ¼-inch, to allow for the expansion of the sheet by the heat of the hive.

The best combs are obtained when the foundation is drawn out by the bees in the super immediately over the brood nest without an intervening excluder.

Combs should be capped at least two-thirds before being extracted, so that the honey will be of good density. When hives are run three stories high, as indicated above, there is no necessity to extract all the honey at one time; one set of combs can be extracted, and the empty combs returned to the hive, and when they are partly filled again the others can be taken. In this way the bees are not upset so much as when all the combs are wet and sticky after extracting, and the risk of leaving the hive destitute of stores is avoided should the honey flow suddenly cease.

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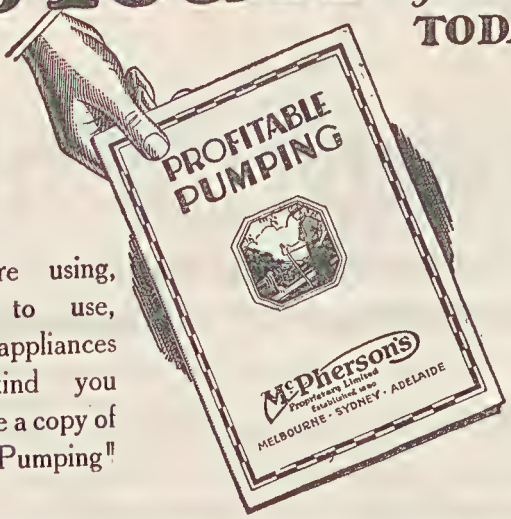

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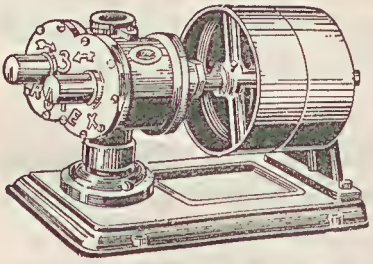

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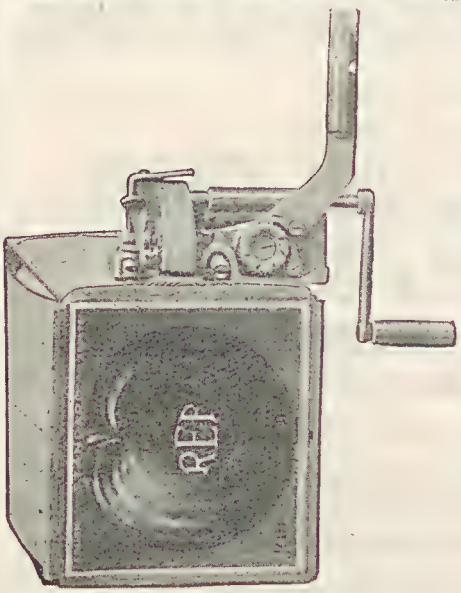

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